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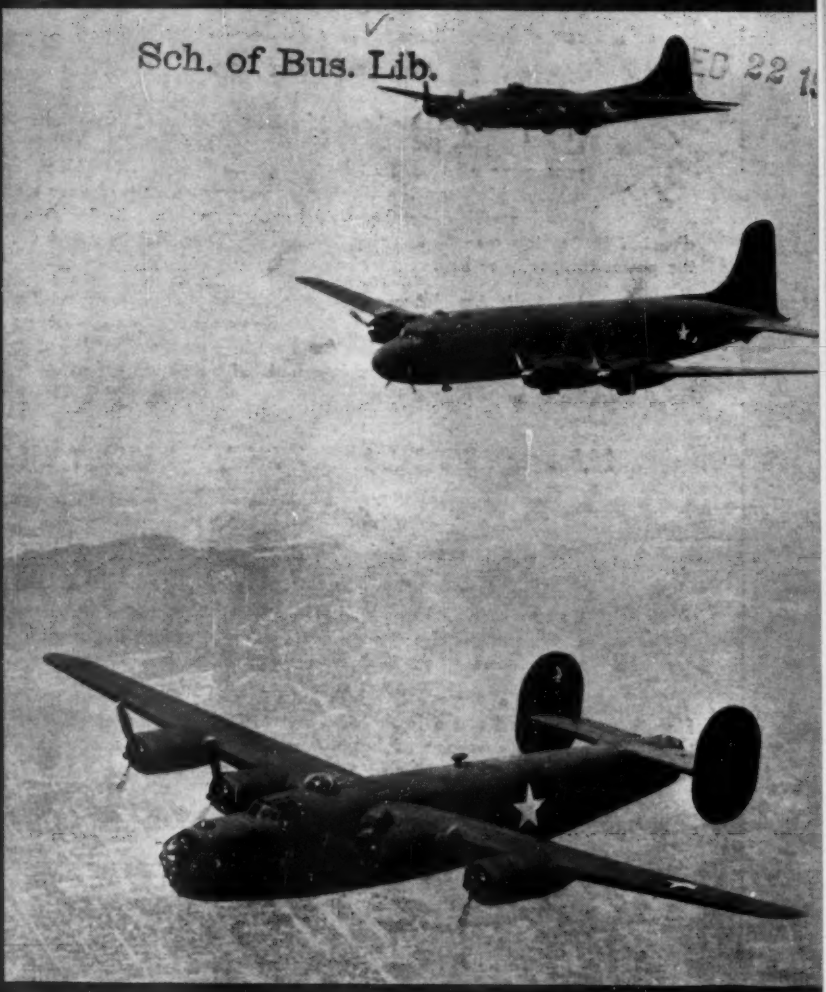

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DECEMBER, 1942

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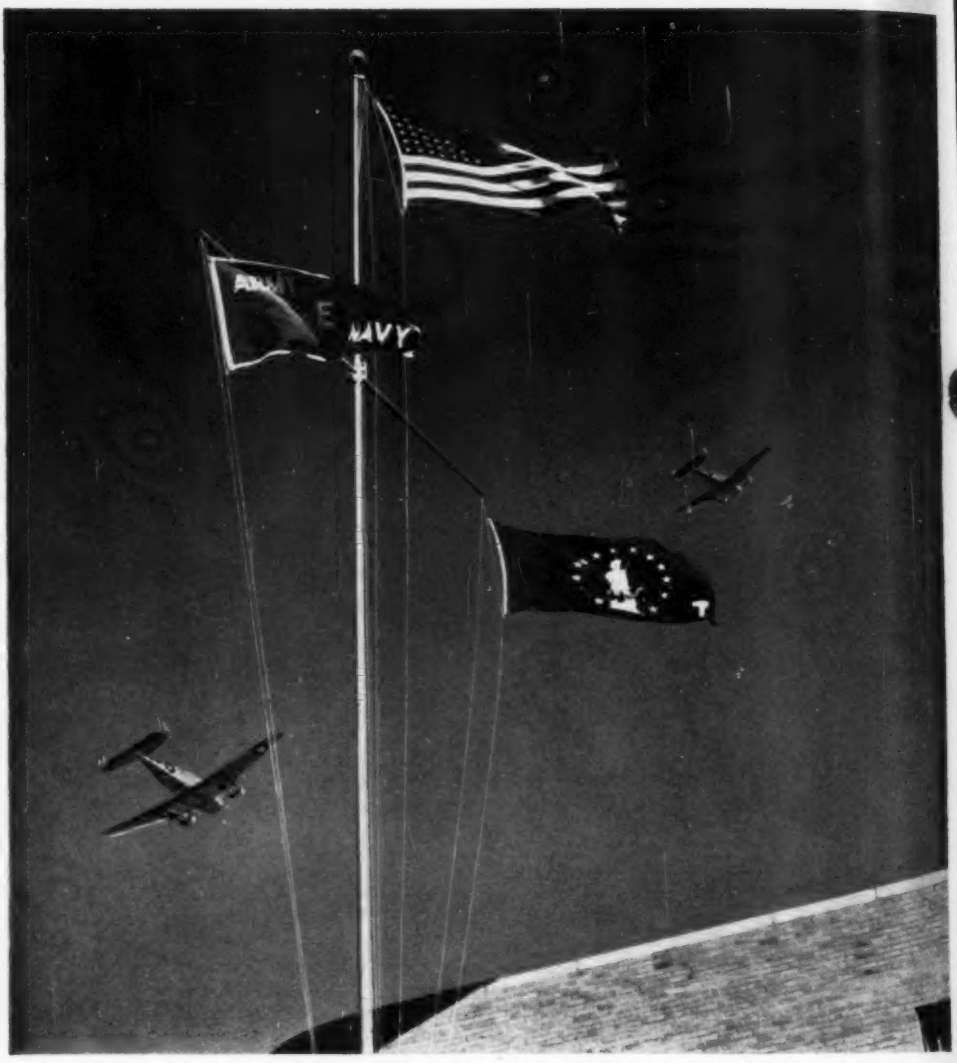
AIR TRANSPORTATION'S COVER

Photographed together in the air for the first time are the Army's three four-engine, long-range planes—the only four-engine military planes in large-scale manufacture anywhere on earth. The Skymaster is Douglas' C-54 (see AIR TRANSPORTATION *for October), the Fortress is Boeing's, the Liberator Consolidated's. Douglas, under war contracts, is now making all three. (Photo by Douglas.)*



Symbols

Beechcrafters are doing their part; and these are the symbols of their devotion

Beech Aircraft CORPORATION

BEECHCRAFTS ARE DOING THEIR PART — WICHITA, KANSAS, U.S.A.

NO SLUGGARDS were the Dutch in launching cargo-by-air. Back in 1926, KLM was carrying planeloads of vegetables like this one from the Netherlands to England for London hotels. The plane is a one-engined Fokker F-7.

The Flying Dutchmen Carry On with Cargo

Despite War, Famed KLM Holds A Place in the World's Air, Especially in the Caribbean

IN the seventeenth century, when the first settlers from the Netherlands landed on the southern tip of Manhattan, the Dutch had already established a reputation as the freight carriers of Europe. The Netherlands' red, white and blue was sailing over all the oceans of the globe, and it would be difficult to find, in any part of the world, a port where Dutch merchantmen were not calling.

Three centuries later, after World War I, aviation enterprises sprang into existence all over Europe. Scores of airline companies were founded. Some perished a few years after their birth, others kept operating on a limited scale. Only a few succeeded in expanding their activities and becoming sound business organizations of international importance.

The old spirit of the Dutch seafarers was still alive in 1919, when KLM, Royal Dutch Air Lines, was founded. The fact that notwithstanding keen competition it became one

of the leading air transport companies in the world, was not for the smallest part due to the attention that was, from the beginning, given to the transportation of freight by air.

The geographical and commercial location of Holland's two largest airports, Schiphol, near Amsterdam, and to a lesser extent Waalhaven, near Rotterdam, greatly favored the development of the air express business. Only a few miles from Schiphol was the center of the Netherlands' famous flower culture, Aalsmeer, where in water-surrounded gardens and tiny farms several feet below sea level, the highest quality of roses, carnations, lilacs and a dozen kinds of beautiful bulb flowers were produced. Only 10 miles farther was one of the main production centers of the finest straw-

ALL-CARGO PLANE, Model 1930. Tiny by today's standards, KLM's 1930 freight plane was probably the world's first designed exclusively for the purpose.

berries, lettuce and tomatoes, all being in great demand early in every season, in luxury hotels in the European capitals.

Pretty rosebuds, still wet with the morning dew, were cut in the early morning in Aalsmeer, brought in speedy motor barges from the island gardens to the huge auction halls, packed in soft paper and special containers, and after that rushed by truck to the airport, early enough to catch one of the first morning planes to Paris, London, Stockholm, Copenhagen, Berlin, and even to Leningrad, Moscow and Budapest in less than 12 hours.

But of course, this kind of traffic had to be developed. The higher freight rates had to justify themselves. The grounding of a plane for half a day at an intermediate airport, on account of weather conditions, might mean the loss of thousands of dollars of perishable, costly flowers. Therefore, only after the airlines had succeeded in operating on close to 100 per cent regularity did this business evolve to its full potentiality. A few years later, over 35 per cent of all air cargo shipped via KLM consisted of perishable merchandise.

Another product that accounted for a large share in the total freight was newspapers, of which thousands of pounds daily were shipped, particularly from London, to various places on the continent. As early as 1929, KLM inaugurated a special daily service, leaving London at daybreak, with over 1,500 pounds of newspapers; this plane made stops at swank beaches along the Belgian and Dutch coasts, so that Britishers enjoying their vacations would find their regular morning paper at their breakfast tables.

A great variety of articles was sent by air in those early days. Some of them received headline importance, though they would hardly draw any attention in these times when jeeps and guns are hurried by plane to the battlefronts. In 1929, a non-stop flight of over 1,200 miles, which brought a 1,400-lb. cylinder head to a Spanish port where a Dutch merchant vessel was held up by engine trouble, was a real sensation.

In its first year of operation in 1920, KLM carried 50,000 lbs. of freight. By 1930 this figure had increased to nearly 2,500,000 lbs. But from then on the growth became slow; the prelude to war had started. Trade limitations, quotas, higher and higher import duties, were all slowly but steadfastly killing international trade, creating controversies and difficulties.

Nevertheless freight carried by KLM in 1935 passed the 3,000,000-lb. mark; in 1938, 4,200,000 pounds were shipped, but in the summer of 1939, with war clouds massing over Europe, freight transport showed a rapid decline.

To a certain extent, unstable trade conditions in Europe after 1930 caused an increase of the air freight figure. This time, however, it was not vegetables and flowers, not newspapers and movie films, not the latest fashions and jewelry from France. It was an enormous transfer of gold between the various banks from one capital to the other. Much lower insurance premiums for transport by air largely offset higher freight rates. The short delivery time from bank to bank was considered a great advantage. There were days when six to seven trips were made by KLM's planes from Amsterdam to Paris and back, their interiors stripped to allow a heavier load, with no other cargo than gold bars and coins.

The once-famous 9,000-mile Amsterdam-Batavia service by KLM, which cut the traveling time to the Asiatic part of the Netherlands Kingdom down to one-quarter, of course played an important role in the relations between these territories. That the quantity of freight carried on this line did not attain higher fig-

ures was due only to lack of space, as a result of great numbers of passengers and huge loads of airmail. Nevertheless, in 1939 the weight of air express carried to the Netherlands East Indies equaled 300,000 ton-miles.

The bright outlook on air freight in 1930 induced the management to have a special freight plane designed. Speed being only a secondary feature, this "Jumbo" biplane was equipped with a single 450 h.p. Jupiter motor. Its cruising speed was only 95 miles an hour. The fastest passenger planes were already flying at 140. It had a comparatively high payload of over 3,000 lbs. Unusually wide doors and unobstructed space inside allowed storage of bulky consignments.

Extremely low landing and takeoff speed made possible its use in very small fields. This feature proved itself most valuable during severe winters, when often several of the Dutch North Sea islands were entirely isolated from the mainland by the surrounding ice masses. Beside medical supplies and airmail, in a single winter season several thousand pounds of yeast were brought over to these islands by KLM's planes. As on many of the islands no flying fields were available, the landings very often had to be executed on small meadows or on a strip of beach, or on the ice itself.

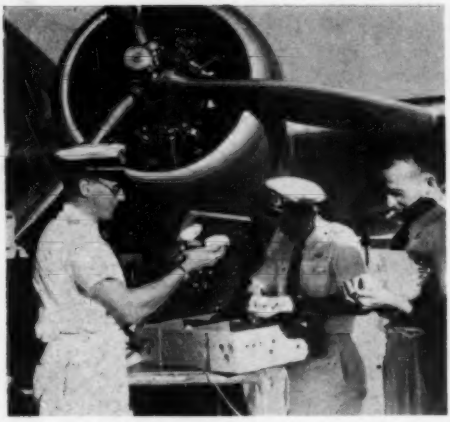
But a short time after the "Jumbo" was put into service, international difficulties began, and growth of freight slowed down to such an extent that KLM ordered no more planes of this type. Thus ended a chapter.

In the West Indies, where KLM opened its first line in 1935, development of air express in the beginning was not outstanding, because of the excellent and fast steamer connections in the Caribbean. The expansion of KLM's air net, of course, accounted for a gradual increase of cargo carried, which in the last year before the war amounted to 120,000 lbs. But U. S. entry in the war, followed by consistent attacks on shipping lanes and withdrawal of merchant vessels from the Caribbean, disrupted steamer services. If practically all the space KLM has available, didn't have to be reserved for important passengers and mail, a much larger quantity of air express could have been carried than the 260,000 lbs. which will be actually shipped in its planes this year.

In the first years of operation in the West Indies, newspapers, magazines, movie films, fresh flowers from the mountain regions in Venezuela, and thousands of baby chicks from Florida were carried by air to Curacao and Aruba. Now, far less expensive and nonperishable goods also are sent by air. Not long ago one of KLM's Lockheeds, which on a charter flight brought a number of passengers over 400 miles of sea to one of the other islands, returned with nothing less than a consignment of 2,000 lbs. of cheese.

KLM's well-known sister company, KNILM, Royal Netherlands Indies Airways, which

***STRAWBERRIES FOR SCANDINAVIA** were the cargo of this 1927 KLM plane, being loaded at a Netherlands airport. Even this early, the Royal Dutch cargo poundage was approaching 2,000,000 a year.*



BABY CHICKS, one of air express's oldest standbys, arrive via KLM plane in Curacao, Netherlands West Indies, from Florida, on the Dutch Caribbean service.

started operation in 1929, and which in 10 years created an extensive air net connecting even the most distant posts in the wide-spread archipelago, and established the important extension of KLM's Amsterdam-Batavia line to Australia, long foresaw the enormous significance of the shipping of freight by air.

Whereas part of its air express consisted of articles of luxury, with fresh flowers and vegetables from the cool mountain resorts to the tropical coastal towns, as well as fashion goods and movie films, even more important was the speedy transportation of medical supplies, tools, replacement parts for machinery and the enormous variety of goods that are needed by people working in the jungle, where often no other means of transport is able to penetrate.

Both KLM and KNILM have suffered heavily in the war. Many of their planes were damaged beyond repair during the invasion of Holland, as well as in the East Indies. Several members of the flying personnel lost their lives during gallant performance of war duties. Both companies have assisted evacuation of scores of people from war-infested areas. Both now carry on to the best of their ability with the limited means they still have and render valuable contributions to the war effort in many parts of the world—the details of which are, more often than not, necessarily veiled by military secrecy.

They are preparing thoroughly for resumption of full activities when the Axis menace is conquered, and air transport will become an even greater instrument for fostering peaceful relations among the peoples of the earth.

Medicines Fly South, Rubber Soars North Via Cargo Airplanes

Southbound cargo planes, the Coordinator of Inter-American Affairs reveals, are carrying medical supplies for the new health and sanitation program which is designed to support development of rubber and other resources in Latin American republics.

On the northbound flights, one of the principal air cargoes is expected to be rubber. Cargo planes may provide the answer to the transport problem in getting rubber out of the interior of the vast Amazon Basin.

Development of the Amazon and other tropical rubber-bearing areas requires extensive health measures to protect workers against malaria and other diseases. Officials handling medical supplies reveal that 15 complete medical dispensaries have been flown south. Others are scheduled to follow. Millions of atabrine tablets, synthetic substitute for quinine, like-

wise have flown south to Brazil and other countries. Gathering of medical supplies for the sanitation program in the Amazon in this country was supervised by Dr. Kenneth C. Waddell, pioneer authority on sanitation measures for rubber development in the Amazon.

A report from Lima says Faucett Aviation Co. of Peru has completed exploratory flights to rubber-gathering bases established at the headwaters of the Amazon, where the borders of Brazil, Bolivia and Peru meet.

ALL AIR MAIL packages, except letters, must now be subject to opening and inspection by postoffice employes, Washington has announced. Obvious purpose is to make certain that explosives, inflammables or other items that might damage or destroy transport aircraft and their cargoes shall not be shipped. It is suggested that users of air mail present parcels for mailing unsealed, so that the contents may be checked before sealing.

Keep Air Cargo's Feet on the Ground

United Air Lines' President Decries Enthusiasts Who Doom Ships, Railroads

By W. A. PATTERSON
President, United Air Lines

TODAY there is considerable discussion of the postwar future of the airplane, and public opinion seems to range all the way from the feeling the airplane is "here to stay" to the unbridled feeling that the airplane will drive other forms of transportation out of business.

It seems only a few years ago when the value of the airplane to national defense and its ultimate place in our social and economic system was a matter of considerable question. Actually, 15 years ago public confidence in and acceptance of the airplane was at its lowest ebb.

Now, however, the pendulum of public opinion seems to have swung from that extreme to the other. Those of us who have had confidence in the future of aviation in years gone by now see that confidence supported by actual performance. As an instrument of destruction and as a medium for the transport of men and materials of war, the airplane has become tremendously important. Public opinion has reacted quickly to this situation and is now headed in the direction of extreme enthusiasm over the postwar future of the airplane.

As one who has been active in aviation for 15 years, I have great confidence in the postwar future of aviation. I firmly believe that in the peacetime to come the airplane will occupy an important place in the international scheme of transport and communications of our new world. On the other hand, I feel that *this picture is being distorted perhaps in a harmful way by overenthusiastic predictions of the influence of the airplane in the postwar world.*

My purpose in these remarks is to rationalize these statements about the part the airplane will play in our future lives, as I feel it is important to clarify our present perspective of postwar aviation. I should like to combine this objective with a thorough discussion of my own appraisal of the healthy future which I believe aviation will enjoy . . . .

I would like to examine just a few of the overoptimistic statements which are currently being made by people within as well as without the aviation industry and see how they stand up under the test of the facts as we know them today. Such statements as the following are typical of what I believe to be the overenthusiastic viewpoint of aviation's future prevailing in many quarters today:

"*Inexpensive transportation is* inherent *in the airplane itself.*"

"*The airplane is destined to be the* least expensive *form of transportation known to man.*"

"*The airplane will be completely accepted as the* only *suitable means of intercontinental travel.*"

"The U. S. should immediately undertake to provide an air fleet designed to carry the bulk *of the nation's and the world's cargoes."*

We all have great confidence in the future of our business and we have all made enthusiastic statements in regard to its future development. I, for one, have stated on many occasions that the airplane is going to revolutionize our social and economic habits as we have known them to be in the past, and as a result this will have the effect of changing our methods of merchandising and distribution. I still believe this firmly.

Enthusiasm is the greetest asset any management can possess in promoting the development of its business. However, overenthusiasm can lead to failure in expectations. When statements are made that our older forms of transportation, the railroads and steamship lines, are doomed, such statements cannot be be supported by facts.

Air transportation will augment surface transportation, not supplant it. Surface transportation will progress as a result of air transport's development, rather than be retarded by it.

As a result of the war, we are now seeing a widespread use of air transportation because of the strategic value of "getting there first with the most men and materials," as well as because of a shortage of surface shipping, and in certain areas the entire absence of any means of transportation whatsoever.

When we evaluate the use of the airplane in our present war activity we must realize that cost is an unimportant factor in our wartime transport formula. In peacetime commerce, we do know that the dollar cost of transportation becomes all-important in determining the transport method which will be used. Therefore we must keep in mind that the conditions of today are not normal, and to guide us properly in our thinking toward our future we cannot ignore the fact that in normal times transportation represents a real part of the cost of the consumer goods to be sold and purchased.

The first job facing all of us is to win this war. We all know the outstanding job being done by all forms of transportation in our war effort. The service being performed by the railroads, for example, is a most spectacular performance.

The vital part air transportation is playing in this war will not be fully known until some day in the future, because of the confidential nature of many of its present activities. We can say, however, that the flexibility of the airplane is proving of immeasurable value. The territory served by air transportation companies of this country is far greater than the average person realizes. We have not been limited by the boundaries of land or water. . . .

All transportation is today accomplishing outstanding results in about the same manner. We are obtaining greater utility from our equipment with equal efficiency and safety. We have eliminated duplicating and competitive schedules. One of the principal reasons for our success has been the result of the sacrifices being cheerfully made by our patrons, because the passengers' convenience, which has been our primary objective in the past, is today secondary to the furnishing of transportation necessary to our war effort. . . .

Railroads and steamship companies, aroused by the many enthusiastic statements regarding the future of air transportation, are studying the postwar problem to see if they, too, should take to the air. This will be decided on the facts developed in study and will, of course, be influenced to a great extent by government policy. We do know that all studies made prior to the war do not disclose practices or facilities existing in common on both the airlines and railroads that would bring about any economy as a result of consolidation. The one and only common objective is the desire for business. We will definitely be competitive for certain types of passenger business and certain types of express. The gains the railroads will achieve in freight traffic which will be created by the airplane will more than offset their loss of passenger business to the airlines.

Let us examine the relative cost of freight transportation by surface means and by air. These comparative costs which I will give you are the result of much research and study by our statistical and economic research department to find some of the answers ourselves.

So important do we consider Mr. Patterson's statement on air cargo that we are publishing it virtually in full as delivered this month in New York. The more air cargo's advocates adopt his hard-headed sanity of outlook, the faster real progress will be.—*The Editors.*

They are, of course, based on the operating costs of present airline equipment, such as is now in commercial operation throughout this country.

First, let us compare the freight train with the cargo airplane on the basis of normal peacetime conditions.

The average freight train would consist of 50 cars, 30 of them loaded with 26 tons of freight each, and 20 of them empty. Such a freight train, based on actual railroad statistics for the year 1940, would carry a total of 780 tons. Operated between Chicago and San Francisco, it would give sixth morning delivery and could make two round trips in a month's time.

Trains, Planes Compared

Therefore, every month it would deliver a total of 1,560 tons each way between those two points. An oil burning locomotive pulling this train would consume 170,000 gallons of fuel oil during the month, which at two cents a gallon would cost $3,400. The operating crew on such a freight train would number five men, and an equivalent of four crews or 20 men would be required to keep the train running. Their total pay would be approximately $5,000 for the month. The total operating cost of the train, based on 1940 railroad experience, would amount to $50,000 for the month, which represents the cost of moving 1,560 tons by rail from Chicago to San Francisco, and another 1,560 tons from San Francisco to Chicago during the interval of one month, or two round trips.

Now, let us do the same job by airplane, using the familiar Mainliner type of equipment which is now in use on our line, but converting it to small cargo-type airplanes. The average lifting capacity of such an airplane would permit it to nibble in small bites of only 2¼ tons each at the 1,560-ton pile of cargo moved by the freight train in one month's time. It would take 626 bites, or 626 airplane round trips between Chicago and San Francisco to do the same job that the freight train did in two round trips. This represents 2,500,000 miles of flying compared to 8,880 freight train miles.

A single airplane could not make that many round trips between Chicago and San Francisco in a month's time. Normal operating experience would indicate 11 round trips per month per airplane as the average. On this basis 57 airplanes would be required to do the job of the freight train. During the month these airplanes would consume 1,500,000 gallons of gasoline, compared to the 170,000 gallons of fuel used by the train. The gasoline would cost a total of $200,000 compared to a cost of $3,400 for the fuel used by the train. Four hundred pilots would be needed to fly the airplanes as against 20 crew members to keep the train running. The pilots would receive a total of $200,000 in pay for the month while the payroll for the train crew members would amount to $5,000.

Based on recorded experience, the total operating costs of the airplanes would amount to $1,750,000 during the month while the freight train costs would total $50,000. The airplane operation would therefore cost 35 times as much as the freight train.

What has the airplane contributed to the economic picture in return for this large additional expenditure? Speed? In both examples the same number of tons have been moved the same distance in the same length of time —the ton-miles-per-hour are the same. Of course, two freight trains could move the entire 1,560 tons from Chicago to San Francisco in six days time and our airplanes could do it in about half a day, if 626 of them were assigned to the job—but that is another story. Prior to Dec. 7, there were only 362 commercial transport airplanes in use on all the airlines in the United States.

For the large bulk of commodities, speed in transit is a relatively unimportant consideration. The most important factor is the *rate of flow*—the laying down at destination of a given number of tons per month.

Mainliner Equals Box Car

In the example I have given, one Mainliner-type cargo airplane was approximately equivalent to one freight car in the amount of work accomplished per month. If the airplane is to be visualized as taking over the entire job of all the freight cars in the country this is perhaps an unfair comparison. Due to the long-haul nature of our example, we made the freight car work overtime, 300 miles a day, as against an actual country-wide annual average of only 36 miles a day. If the airplane were to take over the entire job being done by the nation's freight trains, its efficiency might be expected to drop too, because of the short-haul characteristics of the preponderance of traffic, the unbalance between directional movement, seasonal fluctuations, and the tremendous terminal problem that would result.

A fair comparison might be to expect one of our present-day airplanes to do the work of

three freight cars. It is reported that we have in this country 1,800,000 freight cars and on this basis 600,000 transport airplanes of the present commercial type would be required to replace them. *During a year's time these planes would consume 122 billion gallons of gasoline, which is two and one-half times more gasoline than the pre-war cracking equipment capacity of all the refineries in the world.* Two and a half million pilots would be needed to fly this fleet, and the total airline personnel would run to 20,000,000, or 15 per cent of our entire population. This would be a very substantial contribution to the solution of any postwar unemployment problem, if only the cost were not so great.

And As to Ocean Cargoes

Let us now turn to a comparison of today's ocean-going freighter and the cargo airplane. For our freighter we will use a vessel of 13,000 tons loaded displacement similar to the type currently being constructed in great numbers by our shipyards for the Maritime Commission, and we will sail it between San Francisco and Brisbane, Australia. The revenue load of such a ship would be 6,400 short tons, and in peacetime operation it might be expected to make the round trip of 14,000 statute miles in two months' time. The fuel oil consumed for the round-trip voyage would be 425,000 gallons, which would cost about $9,000. There would be 55 in the crew and their pay for the two months' period would total $15,000. Based on the experience of a coastwise shipping company, probably high for trans-pacific operation, the total operating costs chargeable against the two-month round trip would be $120,000.

The airplane we are going to use to perform this same job of moving 6,400 tons of freight from San Francisco to Brisbane and another 6,400 tons on the return trip, all in two months time, would be of the four-engined type which but for the war might be in use on our airlines today, and which is currently being used by the Army in some of its transport operations.

Such an airplane would carry four tons of revenue load over the distances required between fuel stops, and therefore 1,440 trans-pacific round-trip flights would be required over a period of two months to transport the load carried by the surface freighter in one round trip. This requires an airplane departure every hour, and represents 21,000,000 miles of airplane flying compared to 14,000 miles of surface ship travel.

An airplane can make the round trip in six days and therefore could fly 10 round trips in the two months. One hundred and forty-four airplanes would be required. These airplanes would consume about 18,000,000 gallons of gasoline while the boat was burning less than a half million gallons of fuel oil. The cost of this gasoline would be $2,250,000 compared to $9,000 for the ship's fuel. Thirty-five hundred airplane crew personnel would be needed as against 55 men to man the boat. The airplane crews would receive a total of $3,000,000 in pay for the two months compared to $15,000 in wages paid to the ship's crew. Total airplane operating costs, based on present figures, would reach an aggregate of $29,000,000—250 times the surface freighter's round trip cost of $120,000. Again, both have performed the same job in ton-miles-per-hour.

Refueling is still another problem that the airplane would have to meet in competing directly for the more substantial tonnage capable of being carried by the ocean vessel. Nearly 15,000,000 gallons of gasoline would have to be transported to intermediate points and to Australia every two months by ocean-going tankers. Three such tankers would be required for this purpose so that actually 144 airplanes plus three tankers would be required to do the job that could be accomplished by one ocean-going freighter in the first place.

Must Figure All Costs

These figures which I have quoted are interesting, but their main significance is not appreciated until we *trace this transportation cost to the value of some typical commodities that you and I find it necessary to buy.* For example, of our total exports to Australia the most important single group in terms of value is machinery. Typical of this group would be one-third horsepower electric motors, which have an export value of about 30 cents a pound. From the comparative cost figures that we have just developed it can be computed that the rail transportation cost of these motors from Chicago to San Francisco would be eight-tenths of a cent per pound, and the shipping cost by surface vessel from San Francisco to Brisbane, Australia one-half cent per pound. The total cost of transportation from Chicago to Australia, amounting to 1-1/3 cents a pound, is equivalent to four per cent of the value of the motor. That is the transportation cost by surface means. If shipped by air, the cost from Chicago to San

Francisco would be 31 cents per pound (slightly in excess of the value of the motor), and from San Francisco to Brisbane $1.28 per pound. The total is $1.59—over *five times the per-pound value of the motor.* This high transportation cost might be well justified if some plant in Australia were shut down due to motor failure and no replacements were available locally. By use of the airplane the plant could be operating again in four days, whereas if the replacement motor were shipped by surface means, four weeks would elapse before the situation could be remedied. Under such circumstances such a high tariff would no doubt be justified, but for the large quantities of motors needed to meet normal demand, the high cost of transportation by air would be hard to justify.

Wool vs. Platinum Cargoes

On the return trip a typical commodity imported from Australia is raw wool, also having a value of about 30 cents per pound of shipping weight and therefore would give us the same effect on the cost of such wool laid down in San Francisco. Among our 1940 imports from Australia there is listed 558 ounces of platinum valued at $26,000, equivalent to a value of $560 a pound. Here the cost of air transportation would amount to three-tenths of one per cent of the value of the commodity—a ratio making such shipments entirely practical. Unfortunately, there were only 558 ounces to be shipped.

Admittedly, these examples are based on present-day costs which are without question high because our business is relatively new and we haven't yet had the opportunity to take advantage of all possible economies. Furthermore, I would not want to leave the impression under any circumstances that we haven't confidence in our ability to take advantage of technological advances in the design of equipment and increases in the efficiency in the use of equipment that will bring about very major economies. But these examples afford an idea of the magnitude of the problems that must be solved and the time required to solve them if the cost of air transportation is ever to be brought down to a level where it can compete with surface transport on a strictly dollars and cents basis.

There is still much uncertainty as to the cost of operating the giant airliners projected for the future. Most studies we have seen treat direct flying costs in considerable detailed accuracy and then slap on overhead on the basis of a fixed percentage. This is the procedure usually followed by those who have not had the opportunity of actually being engaged in airline operation. They have given very little attention to the evaluation of terminal costs, and pickup and delivery of merchandise either side of the terminals. Surface carriers have found that their terminal costs are at least equal to and often greater than their over-the-line costs.

Little thought has been given to the fluctuation of traffic within the day, from season to season, or to the unbalance in directional traffic flow, or to the short-haul nature of the greater part of all traffic. All these things tend to set limits on utilization and load factors which no one other than those engaged in the business can determine.

Our engineering research department has tabulated the possible reductions in direct flying costs that might result from a full realization of all the technical advances that are now in the development stage. Included are such possibilities as:

1. Design of the aircraft to suit the job which it must perform.
2. Higher lift and lower drag characteristics.
3. Advances in structural design and materials, allowing major increases in useful load capacity.
4. Power plant improvements such as lowered fuel consumption, partial set propulsion.
5. Improvements in terminal and aircraft loading and unloading facilities.
6. Improved airports-layout and size.

Costs Will Drop Some

All of these things taken together might reduce direct flying costs as much as 60 per cent, but taking overhead costs into consideration total costs would probably be lessened only by about 35 per cent. This would be at current traffic volumes. The effects of increased volume in reducing costs is well known in all lines of business. In the air transport industry based on the record of its performance to date, and assuming that the law of diminishing returns will not begin to exert its tempering influence, we might logically assume that a hundredfold increase in all traffic volume from today's levels would result in a further reduction of 60 per cent in total unit costs. Therefore, the combined effect of all the presently contemplated engineering advances plus a hundredfold increase in volume might be expected to reduce overall ton-mile costs from their present

average of around 40 cents to levels somewhere in the neighborhood of 10 cents per ton mile, still many times the cost of surface transportation which measures its ton-mile costs in mills.

We must also bear in mind that *while the air transport business is reducing its costs the railroads and the steamship companies will be doing the same.* I have the greatest respect for the management of our railroad systems in this country and I am sure that they will also be making progress, particularly as a result of the benefits in the experience of doing the grand war job they are accomplishing. Improvements in their rolling stock and trackage, held in abeyance because of the war, will some day provide additional tools in their competitive sales kits.

With the potential for greatly lowered costs existing in all fields of transportation, it appears to me logical to assume that there will be a tendency to maintain present cost differentials, or at least to put a brake on a possible converging trend.

Air Revolution Coming

One may conclude from these remarks that air transportation's future is not particularly bright. I want to emphasize again that my objective here is simply to rationalize the overenthusiastic statements being made which can be temporarily damaging to the interests of all transportation.

As I see it, air transportation is going to revolutionize practically every social and economic viewpoint and practice. In the field of passenger travel, the airplane may well take over a major share of the volume. Passengers as a commodity have a high value per pound and per hour and require a relatively large amount of cubic space. These factors combine to make the costs of transporting passengers by surface means and by air somewhat more comparable than is the case with other cargoes. Individuals are also influenced by consideration of convenience, comfort and such other intangibles as the romance and prestige associated with travel by air.

But an inanimate piece of cargo presents a different problem. Here values per pound bear a much lower relationship to transportation costs. The time saved must be business time, and it must be strictly worth the saving, and weight can be concentrated in a much smaller space. We have already suggested some of the conditions that must exist in order to justify shipment of freight by air:

1. An emergency has to be met.
2. An opportunity must exist for a substantial saving in warehousing and inventory costs.
3. Commodities must have a value per pound sufficiently high to make possible worth-while savings in financial and insurance costs.
4. Surface transport must be inadequate or nonexistent.

In the future field of transportation the airplane can make an increasingly important contribution over the years, as its operating costs are gradually reduced through technological advances and increased volume. But there is another—and perhaps most important—contribution that the airplane has to make to civilization. We see indications of it by carefully analyzing what is going on in the field of transportaton in the world today. For example, take the following items clipped from a publication of the U. S. Department of Commerce:

Portents and promises to world trade are seen in the air-freight service being developed between the United States and the nations helping it to fight this war. For some time it has been known that Army and Navy ferry planes have been speeding war goods to far-distributed outposts; they cre also bringing back equally vital raw materials without loss.

* * *

Block mica has been flown in from India. Planes returned with $475,000 worth of platinum from the Persian Gulf and with beryl ore, quartz crystals, industrial diamonds, and mica from South Africa. Crude rubber has been air-freighted from Brazil, balsa wood from Central America; 20 tons of rubber seeds were ferried from Liberia to the Western Hemisphere.

* * *

Tonnages involved are sometimes tremendous—at least for air freight. In eight weeks, 32 tons of bristles for the Navy, 70 tons of silk for parachutes, 47 tons of tin, and 70 tons of tungsten were moved from China to India. Later, 98 tons of tungsten were flown out in 10 days.

* * *

One of the most striking uses for planes was the dispatch of beetles from the Fiji Islands to Honduras to check a root weevil attacking hemp growing on an experimental plantation.

* * *

In each of these examples the commodity

was flown by air because an emergency existed or because surface transportation was temporarily inadequate or did not exist. All over the world steps are being taken to remedy deficiencies in surface transportation as rapidly as possible. The airplane has opened up Alaska to our armed forces, but the Alaskan Highway, just completed, will henceforth carry the great bulk of supplies necessary to maintain them there.

Across the Andes in South America, between Chile and Argentina, an airline is already operating, fostering the community of interest of the two areas served. A trans-Andean railroad is now being built between these two points which, when completed, will facilitate the exchange on a volume basis, of the agricultural products so badly needed by this area of Chile, and for mineral products needed by Argentina.

Railroads Still Being Built

We read of a new railroad bridge just completed linking for the first time the railroads of Mexico and Guatemala, enabling surface transportation in greatly increased volume of strategic materials heretofore moved by air. In the Yucatan Peninsula in Mexico, chicle has long been brought out of the interior by airplane. The volume has grown to a point where a railroad is now being constructed from this area to connect with the Mexican trunk lines. The effect should be a substantial reduction in the transportation costs of the products from this area.

The capture of the Burma Road by the Japanese created an emergency which the transport airplane has been filling admirably. But surface transport is so vital to the movement of the great bulk of supplies needed by China that two substitute roads are being pushed to completion as rapidly as possible.

In Africa, where in many areas the camel is the only means of surface transportation, the airplane has again pioneered and has made it possible for our armed forces to effectively establish themselves in that area. But again, roads and rail lines are being laid down as quickly as possible so that the larger traffic volumes required by an expanding activity can be effectively handled.

These examples in themselves provide a pattern for the role of air transportation in the post war world. The airplane will facilitate and speed up the exchange of ideas through personal contact, and by written word. Community of interest will be aroused and made to grow. Personal and business travel, never before possible by slower surface conveyances, will be created by the airplane. Better and more widespread first-hand understanding of other peoples' problems and ways of living will result. The thinking and methods of the more progressive peoples of the world will more easily and rapidly be spread to the more backward nations, tending to accelerate an increase in the standard of living throughout the world.

First Class Mail To Fly

The natural result of all this would logically seem to be a growth in world trade, an increasing demand on the surface carriers for the economical moving of the bulk of the world's goods in trade.

And with a general increase in trade levels, the airplane will find increasing work to do in sustaining the economy it will help to create.

Political emissaries, business organizers, salesmen and their samples—all of these will find their spheres of influence made enormously more effective through the use of airplane travel. *All first-class mail, and a large share of express package traffic* will find the airplane a most efficient medium to use in their mission of promoting the general well-being of the world.

The future of the airplane in commerce is indeed great—but it appears that this future can be realized without serious inroads upon the steamship lines or the railroads.

Still 'Drop in Bucket'

The volume of domestic air cargo could increase one-hundredfold and yet capture only one-tenth of one per cent of the freight ton-miles now carried by the American railroads. But apart from that, the airplane should be expected to stimulate the generation of the type of traffic that is the rightful field for surface carriers.

In fact, the business of air transportation can be considered as a sales department for the whole transportation industry, promoting traffic that will redound to the benefit of all forms of carriers, with each type fulfilling those requirements in our future economy peculiar to its own inherent characteristics.

SWEDISH AMERICAN AERO, subsidiary of Swedish American Line, is seeking permission for an air line between Sweden and the U. S. to be placed in operation after the war, the American Swedish News Exchange says.

The War Department Weighs Air Cargo

Assistant Secretary Lovett Calls for Saner Approach To Planes' Real Abilities

When professional enthusiasts talk about AIR CARGO's *power to win the war and remake the world, that's one thing. But when the War Department itself, speaking through Assistant Secretary Robert A. Lovett, lets down its hair, that's quite another.*

Coincidence it may or may not be, but in the same month that Assistant Secretary Lovett cautioned the Academy of Political Science to keep its thinking out of the clouds of impossibility, President W. A. Patterson, of United Air Lines, was saying much the same thing from the aviation industry's viewpoint.

AIR TRANSPORTATION *is proud to present both viewpoints, Mr. Lovett's below, and that of Mr. Patterson on page 9.*

By ROBERT A. LOVETT, *Assistant Secretary of War for Air*

AIR transports, or cargo planes, are vital members of the combat team of our Army. They are multi-purpose planes of our balanced Air Force, serving with both the Air Transport Command and with the Troop Carrier Command. Our transport planes are classified as "tactical" and are called "service-combat planes", which indicates their dual function, as compared with the fighter or bomber, which is a single purpose plane.

Transport planes are as vital to an air force as motorized equipment is to an Army Division. This fact, plus heavy shipping losses and the desire to find some quick solution of the problems thus raised, have fostered wild claims for air carriers and have, unfortunately, led to much loose talk, false hopes and misrepresentation of the transport plane's proper sphere and its possibilities. . . .

Our transport planes are, as I have said, multi-purpose. They are extraordinarily flexible. The plane which is carrying ammunition from a reserve depot to a combat area today may be carrying paratroops over enemy territory tomorrow. They are specially designed for several uses—they have stiffened floors and wide doors to permit the loading of cargo such as engines, spare parts, supplies, special equipment and the great mass of items that an air force and an army needs. But in addition to this, and in many cases of greater importance, they must carry combat teams in support of ground troops—airborne infantry, parachutists, field pieces, special weapons, etc., which must be taken into the combat theater or over the selected target. Therefore, on analysis, their dual function actually has a single aim which changes in character only as the aircraft itself moves from its work behind the lines into a combat zone. It is obvious that troop carrier squadrons are compelled to develop special techniques, but it is equally apparent that the general problem of handling, maintaining and operating the planes is identical.

Transport planes today present *a picture of limitless possibilities within their proper field and of disappointing limitations if they are improperly used.* Unlike cargo vessels, whose function is limited by a shore line and whose operation of necessity must require reasonably safe unloading points, the Army transport plane, whether serving as cargo or troop carrier at the moment, has no natural limiting barrier except its own range, and has as its

specific duty in certain circumstances the job of bringing needed men or supplies into the battle area itself and either dropping them from the air or landing them on the ground. It is important to bear this essential distinction in mind in order to avoid falling into the trap of comparing airborne cargo planes with seaborne cargo ships. Their functions, speed, faults and virtues are entirely different.

Air Supply Routes Grow

The tactical use of transports is, at this particular time, a matter which unfortunately we cannot discuss with frankness for reasons of military security. We can say, however, that *to date we have seen only the beginnings* of imaginative employment. Press reports during the past two years have made the use of parachute troops a matter of common knowledge. It is likewise known that transportation of reserves and of supplies by air played an important part in Rommel's Libyan campaign and did much to offset the effects of the Mediterranean blockade set up against him. Such examples are perhaps adequate to point out obvious military virtues of the cargo plane.

But all direct combat uses at present become relatively small compared with the amazing expansion of the use of our transport planes to maintain vital supply lines to our fighting units now engaging the enemy completely around the world. A large portion of the public does not realize that Army Air Forces are meeting the enemy in combat every flying day on nine widely separate fronts all around the world. In this global war the problem of supply and maintenance of weapons as fragile as high-performance aircraft would be quite impossible without the cargo plane and without the system developed by the Air Transport Command, which combines civilian contract carriers for the type of operation for which they are best suited, with military air transport squadrons in combat theaters.

While full details of these operations cannot be given at the present time, it is possible to give you a few figures indicating the scope and character of the operation. At one stage of Rommel's drive into Egypt the rapidity of his advance resulted in the destruction of certain ammunition stores of the United Nations. We were desperately short of anti-tank ammunition, and if the situation had not been corrected, the result would have been disastrous. The Air Transport Command delivered 25,000 pounds of this sorely needed special ammunition from this country to the front in Egypt in five days. In no other way could this have been done.

In the month of August (the latest fully tabulated figures) the Air Transport Command through its contract lines and its own personnel flew a total of 16,212,560,980 pound-miles exclusive of the African division on which a very large number of miles are flown.

Dramatic as is the work done by the air transport plane, particularly in the magnificent pioneering operations where no other method of transportation exists (such as, for example, in some of our outposts to the North, the routes to the Middle and Far East, and the amazing job done against great difficulties in trying to make up by air for the cutting of the Burma Road) its main contribution to the system of military transportation in this war is that of a supplementary *express* service, not a substitute *freight* service.

But Ships Will Still Sail

The air carrier is today, and undoubtedly will be increasingly, an indispensable part of any military establishment. It has the essential virtues of speed, flexibility, multiple uses and elusiveness. It is the only existing method of getting certain supplies into some parts of the world—not just getting them in on time, but getting them in at all. Its very importance in such operations has misled large sections of the public into having false hopes and into the belief that air transportation offers a quick and easy solution to the logistic problems of modern war. It very definitely does not do this. It is, and will be for several years, an absolutely necessary highly specialized but complementary part of a war transport system.

For some time to come, transport planes cannot, and will not, take the place of ships. There is, in fact, no good reason why they should. There is no need for us to go into detail as to cost per ton mile, consumption of fuel in relation to load and range and all the other statistics which have importance in peace time greater than they enjoy in a war where necessity, rather than cost, rules. I believe the functions of cargo planes and cargo ships can be rather simply set forth by a hypothetical case.

Let us suppose that our problem is to move 100,000 long tons of supplies per month to Australia under present wartime conditions. How many planes of existing four-engine cargo type will it take? How many cargo vessels will it take? How much personnel? Will we

need tankers? etc. The simple table below gives these answers:

San Francisco to Australia—Distance about 6,500 nautical miles
100,000 long tons of supplies a month

	Number	*Crews*	*Fuel*	*Tankers*
Surface Vessels (EC Type)	**44**	**3,200 (including gun crews)**	**165,000 bbls.**	**0**
Cargo Planes (4-Eng. C-87 Type)	**10,022**	**120,765 (flight crews only)**	**8,996,614 bbls. (overseas requirement)**	**85 (large size)**

I believe a study of this comparison will indicate some of the absurdities of the recent "air cargo as a cure-all" excitement in the midst of a war in which we will need all the supplies we can get by land, sea, air.

A large army in this day of mechanized warfare requires an amount of heavy guns, ammunition, tanks, motorized equipment and general supplies of a character, weight and bulk which does not lend itself to the limited cubic capacity of air transportation at this time. Moreover, the serious limiting factor in air freighters at present is their fuel capacity and its effect on their payload. A cargo vessel can carry enough fuel to get its load to the destination abroad and return home. At the present time the airplane cannot do this on long flights. Consequently, fuel has to be carried for it and spotted along the way or at its destination so as to enable it to get back home.

Giant air transports of the future will probably reduce this fundamental deficiency. Such planes are, however, several years in the future and their safe development in the present state of the art requires growth by tested stages. Therefore, for the present and the next few years we must do everything we can to multiply the number of transports of existing types and the much larger ones about to go into production. This the Air Forces are doing and our goal is the maximum number possible without too great a reduction of combat planes during the time of limited strategic materials. From an initial rate of about one cargo plane to five multi-engine combat planes we advance in an orderly schedule until we reach a ratio, under present plans, of about one to two.

And now a word about gliders. The glider has certain tactical uses but it should be emphasized that they are very highly specialized. Because of the fact that they can be built with lighter wing loadings than are generally used in transport planes they can land at much slower speeds and, indeed, can get into fields from which no normal take-off could be made. However, where take-offs and landings can be made from reasonably well prepared fields by well designed cargo planes with proper overload, the use of gliders does not appear to add much to cargo operation. The total load with which a transport plane can take off and fly safely towing a glider is naturally less than it could carry without a tow. It seems at present that the load carried in a glider would normally be only a little more than enough to offset the load left out of the transport to enable it to tow the glider. It has been estimated by competent authorities that it would, on the average, require seven or eight cargo planes, each towing one or two gliders to handle the same total load that could be directly carried in 10 similar airplanes without the complications of the trailing gliders and their crew. In summary, the glider has very special military uses but at present in transportation it is a special expedient for use in special situations.

It must be apparent that we cannot afford to neglect any method of transportation. You will not find any competent airman who is not an enthusiast about air transportation and who does not look forward to the days of specially designed large air cargo planes. Similarly, you will find none who wishes to do air transportation the disservice of claiming something fantastic for it. All of us in the business day in and day out believe that we have only seen small samples of the future of air transportation. Planes now on the drafting boards and in the factories expand the horizon almost indefinitely, and even larger specially designed air carriers will come when design, metallurgy, and technique reach the proper stage. This is, unhappily, some years off and we must use in the war of today and tomorrow the weapons and means of today and tomorrow while research and experimentation, under the forced draught of war, bring us steadily nearer the magic carpet of the future.

Cargo planes may come before Peace

(Why not plan now for Air Freight?)

POLITICAL BOUNDARIES in the post-war world may be shadowy and indistinct. But the fact that there will be overseas air freight running into millions of pounds per year, stands out sharp and clear.

This development may radically change the whole basis of some businesses. It cannot help but change the business thinking of exporters and importers. And it is not too soon today to begin making post-war plans accordingly.

If cargo clippers should come before peace (and they may) wouldn't you like to know the profit possibilities that will open up for your products the day peace comes?

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Because Pan American pioneered both Air Express and overseas Air Freight we have some facts that should interest you. Pan American World Airways System, New York City.

Wings over the WORLD

PAN AMERICAN CLIPPERS

Freight Forwarders Will Aid Air Cargo Operation

Their Services Will Be Vital To Its Fulfilment, Believes Bradley, of Acme Organization

By THOMAS A. BRADLEY

President, Acme Fast Freight, Inc.
in an Address to the
National Retail Dry Goods Association

I COME to the task before me—to express, in some fashion, what I visualize as the potentiality of the freight forwarding industry in the future of transportation. In these trying times a prophet has scant honors. Military and naval experts seem to have been particularly unfortunate as prophets. However, I think I have good precedent for the method I propose to employ. It was not tariff language which Patrick Henry used before the Virginia Legislature, but it was good common sense, when he said: "I have but one lamp by which my feet are guided, and that is the lamp of experience. I know of no way of judging the future but by the past." Therefore, any forecast of the future of freight forwarding must be based on the experience of the past, for the present is nothing but the future of the past.

I repeat the words of Congressman Wolverton to clarify forwarder functions. He stated that freight forwarding—1)—is an agency of transportation; 2)—specializes in the handling and expedition of less-carload shipments of merchandise, and 3)—effectively coordinates the transportation services of carriers by rail, motor-vehicle and water.

Stating it a little bit differently, perhaps more exactly in terms of cause and effect, the two objectives of the freight forwarders may be summed up as:

First, the process of accumulating a diversity of shipments of merchandise from scattered points of origin into an economical quantity, for handling over the longest distance at the lowest possible cost and, correspondingly, at destinations, again breaking down that larger unit into its component parts as small shipments for final delivery.

Second, the selection and use of the particular form of carrier transportation in that phase of the entire movement for which it is best suited.

These two objectives are linked together. The selection of the best medium of transportation is made just as carefully in the gathering and distributing operation, as in the transportation for the longer haul of the large consolidated shipment.

We have all known for a long time that the handling of merchandise traffic in small lots, from scattered points of origin, presents one of the big problems in transportation. Some experts in the field have held that the business of merchandise traffic is not a profitable one for the direct carriers who themselves operate the vehicle of transportation.

But many have come to know that, for those direct carriers, the forwarder method has

largely solved the problem. The forwarder method of accumulation and distribution through planned coordination of services, has converted traffic of an unprofitable type, or at least an indifferent type, into a highly profitable carload or truckload quantity, capable of being handled economically and expeditiously by any form of land transportation. . . .

It is just as essential as turning the wheels of the engine or truck.

Its value as a method has been particularly recognized in these days of equipment shortage. The Office of Defense Transportation has prescribed by directive order, that concentration, a fundamental principle of the forwarder method, be applied by all carriers to the handling of merchandise freight. Their objective, even as the forwarder's has been these many years, is to take the waste out of transportation effort, by consolidation and coordination. . . .

War Is Working Changes

Big bodies move slowly, and it took a directive from the Office of Defense Transportation to apply the underlying principles of freight forwarding to all merchandise transportation. But those same big bodies are irresistible in their movement when they get started. In some quarters, the cooperation in the past has been indifferent, but I find it difficult to believe that the carriers of the United States, having once seen and secured for themselves the economies of that type of handling, will ever revert to the older method, after we have successfully concluded this war. It will have taken a war to make the education compulsory, but the good results of that experience will be continued indefinitely.

I assume, therefore, as my first prediction, that the forwarder method of economical consolidation or gathering and distribution will continue as an axiom of future transportation, in all forms of carriage.

In other words, as I visualize the future, I see freight forwarders playing an ever-increasing role as the gathering and distributing agents of all forms of transportation and it is not beyond the realm of possibility that they may even grow into recognized agencies for the underlying carriers.

Those of you who are near my age group will recall your transportation experience subsequent to the first World War. The fledglings in this gathering who are too young to have had actual transportation experience during that period, have come to know in other ways, that the utility of the truck as a vehicle of transportation was amply demonstrated in that struggle. At the conclusion of the war, the freight forwarding industry began to play a very prominent part in expressing that utility in commercial transportation. . . .

By the use of the new medium—the truck, the forwarders found that they could extend their operations beyond the larger centers into the smaller community, which is normally served as part of the trade area surrounding the larger center. They were thus able to give these smaller communities the benefit of expedited carload movement between the larger centers, by coupling up, at either end of the line, with truck movement.

This coordination of motor and rail transportation gave shippers and receivers at these smaller cities, faster, more convenient and more dependable service than they could get from railroads alone, because the more flexible truck service was superior to the way-train operation, and was coordinated with the rail carload movement by forwarder planning.

Thus merchants in smaller communities took advantage of the dependability of freight forwarder service in accelerating their rate of turnover—in fact, to such an extent that some of the staunchest support for forwarder legislation came from just such localities.

Through planned adaptation of the inherent advantages of this, then new vehicle of transportation, the forwarder made a definite contribution in linking the smaller city with the larger.

And incidentally, the forwarding industry has played an important part—perhaps the most important part — in demonstrating, through the highest degree of coordination, what could be accomplished toward shortening through transit schedules.

I am dwelling at length on this phase of transportation development, because it has a peculiar significance in any survey of the future. We have heard much about the governmental program of decentralization of industry. Many new projects have been located in the outlying districts as part of the national wartime program. Population follows industry.

The end of this conflict, when it comes, is going to find the population of the U. S. more decentralized than ever before in its history. Freight transportation, if it is to adequately serve the country's commercial needs will have to adapt itself to such changed condition. I believe it will, and in the adaptation, the forwarding industry will play an ever-growing part.

It is a fairly safe third prediction that, with proper cooperation on the part of the trucking industry, freight forwarder service will be extended, through coordination, to every reasonable-sized town and hamlet throughout the U. S., to say nothing of utilizing its advantages to the fullest, in fostering still further, our trade with our good neighbors to the North and South of us.

Out of the last World War, transportation benefited from the truck as a medium of handling traffic. I predict that this present struggle will contribute a new form of popular transportation—namely, the ever-widened use of airplanes.

We are living with it daily, in breathless contemplation of its decisiveness in modern warfare. In the last decade, we have all followed, with more or less detached wonderment, the spectacular development of the airplane.

But now that the exigencies of the times have thrust upon us the urgent compulsion for mass production of this weapon, many of us are beginning to think of it in terms of a permanent instrumentality of freight transport.

I believe that at the conclusion of this war, the national policy will result in the United States' continuing to produce and maintain the greatest fleet of planes in the world. The development and continued maintenance of that program is bound to create, as one of its integral parts, the further advancement of commercial aviation, both in passenger and cargo transport, particularly the latter.

We have been reading about the cargo-carrying planes of the Army, and know that they have established an air-transport service within the Army for freight alone.* There are theories advanced lately for the substitution of cargo-carrying planes for transocean steamships.

"Flying Freight Trains?"

We have heard of the "Flying Freight Trains of Tomorrow," involving the possible use of gliders. We have read about the new monsters for air cargo that are on the drafting boards or in the minds of enterprising people. All these things, although many of them are merely in the sensational rather than the rational stage at this juncture, do however, foretell a different transportation picture in the post war world.

It does not take a colossal imagination to realize that we are going to find ourselves, at the end of this struggle, with thousands of airplanes for which a use must be found. Our airplane factories will be all set up with dies, jigs and fixtures for their further out-turn and, as a part of their continued production for military and naval purposes, the manufacturers will be looking for a commercial sideline.

Just as happened at the end of the last war, the existing models and types will be further developed and adapted. What form that will take, I do not venture to predict. The reshaping will, however, be on a pattern of economical operation in flight and in ground service.

With the use of lighter and cheaper materials in plane construction, with improvements in design which our engineering skill is sure to evolve, and with the development of up-to-the-minute methods of freight handling, including radical changes which will be necessary in terminal facilities, methods, and costs, considerable reduction in charges for air freight transportation is inevitable.

But I would like to throw out a warning here, that if the airplane as a cargo carrier is to find its proper and permanent economic sphere, the reduction must come in an orderly progressive way, based solely on scientific designing of the type of plane adapted exclusively to the job of freight carrying, and brand-new methods of terminal handling.

The designing will have to be carried out with an eye to our known high terminal costs in the fields of transportation from which the traffic for this newest vehicle must come.

The airlines of today have demonstrated their ability to render a highly satisfactory service to the nation. They are aggressively and intelligently managed, as their record of service-giving proves. In my judgment, they will not hesitate to take full advantage of the unique position of the freight forwarder as the logical agency with which to cooperate, in the development of the coming new air service for freight, as contrasted with the present air express service.

Forwarders Equipped for Task

The forwarder is ideally fitted to do this job by virtue of his extensive past experience and nationwide coverage. He is better equipped for it than any existing agency. No single railroad could cope with the problem because of the limited scope of its operations and because its direct influence cannot be brought to bear beyond the confines of its own territory.

As I see the future then, we can reasonably expect transportation to be provided in the following forms:

First, and most expeditious, air express.

Second, and only slightly slower—AIR FREIGHT. It will substitute for air express at the smaller communities, and will provide a slower service, at a rate lower than air express, between the larger communities.

Third—expanded forwarder service in coordinated movement of truck, rail or water.

In all these forms of transportation, I envisage the forwarder playing a very prominent part as the agency of gathering and distributing, as well as planning and coordinating the services of the various media of transportation. I think these different forms and degrees of expedited transportation will come as sure as a dry goods store has a package of freight to ship. And I do not see how the newer form can be popularized and all the other transport services effectively coordinated without the intervening presence of a freight forwarder.

Future Is Being Anticipated

The railroad, the steamship, the truck and the airplane—each in its economic sphere, make the whole warp and woof of our transportation fabric. Each has had, and will continue to have, a vital part in making the American transportation system the most modern and efficient in the world. That there will be continued development and improvement in every form of carriage, there is not the shadow of a doubt.

The forwarding industry will be constantly in the vanguard, always on the alert to take advantage of these improvements and give them to the public in increasingly efficient coordination of the services of all forms of transportation.

From the point of view of the National Retail Dry Goods Association, I believe the program is sound as well as inevitable. It dovetails with their own methods and with the outstanding way in which they have been serving the commercial requirements of the people of this country.

I believe I am on more solid ground than a mere prophet when I venture to predict that the association will henceforth give the same degree of cooperation to the freight forwarding industry towards realizing its future objectives, as they have so consistently provided during these many years of close association.

"GATEWAY" to the Canal Zone, Central and South America

FOR SHIPPERS AND TRAVELERS

A Vital Link Between Allies

★ On American Airlines Flagships you can travel, and ship by Air Express, *all the way* to Monterrey and Mexico City. In addition, American Airlines' route provides a "gateway" to and from the Canal Zone and Central and South America. For full information on this and services to any other points, call your American Airlines office. For cargo pickup, call Railway Express Agency, *Air Express Division.*

AMERICAN AIRLINES *Inc.*

ROUTE OF THE FLAGSHIPS UNITING CANADA, U. S. A. AND MEXICO

A Global War Rages

• Every continent and sea is a battlefield. America and her Allies — on the ground, on the water and in the air — fight a life and death struggle on far-flung fronts.

Transporting armies and supplies to these global battlefields presents the greatest transportation challenge of all time. "Armies can never be better than their supply forces."

The Army Air Transport Command, the Naval Air Transport Service and the United States Maritime Commission stand shoulder to shoulder in getting this job done. Under this co-ordinated command, huge air and sea fleets are speeding to the far corners of the globe.

American Export Airlines and American Export Lines, with giant, four-engine flying boats and new, fast cargo ships, are serving in this unprecedented battle of transportation.

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LINES... AIR LINES
25 BROADWAY, NEW YORK

Air Cargo Engineers Hold Historic Meeting

Chicago Gathering This Month Reflects Solid Progress of Air Cargo Development

AIR CARGO *history is being made this month in Chicago. Under the auspices of the elite Society of Automotive Engineers, prime engineering body of the great automobile industry, what will probably be recorded in the future as the first convention of its kind in America is being held on December 8 and 9.*

AIR TRANSPORTATION *here presents the program of that gathering, together with reports on some of the principal addresses which were available at presstime. Other significant facts from the gathering will be published in the January issue.*

A Special

AIR TRANSPORTATION

Report

S.A.E.
AIR CARGO ENGINEERING MEETING

Tuesday, Dec. 8

AIRLINE CARGO PROBLEMS

Chairman: William C. Littlewood, American Airlines

"Deficiencies of Converted Passenger Airplanes for Cargo Operation Requirements"
Charles Froesch, Eastern Air Lines

"Terminal Handling of Air Cargo"
Karl Larson, Northwest Airlines

AIR CARGO OPERATIONS

Chairman: William A. Burden

"Packaging and Handling of Air Cargo"
C. G. Peterson, Railway Express Agency, Inc.

"Some Aspects of Air Cargo Operation in Latin America"
J. Parker Van Zandt, Office of Air Transport
Information, Department of Commerce

"The Economics of Post-War Carriage of Air Cargo"
J. V. Sheehan, Lockheed Aircraft Corp.

DINNER

Chairman: R. D. Kelly, United Air Lines
Toastmaster: W. B. Stout, Stout Skycraft Corp.

"S.A.E. War Effort Activities"
Col. A. W. Herrington, President, S.A.E.

"Naval Air Transport Service"
Comm. C. H. Schildhauer, Naval Air Transportation Service

"The Importance of Air Cargo in the War Effort"
Col. Harold R. Harris, Assistant Chief of Staff,
Plans Div., Air Transport Command, Army Air Forces

Wednesday, Dec. 9

DESIGN SESSION

Chairman: P. Altman, Vultee Aircraft

"Securing Means for Air Cargo"
Col. E. S. Evans, Evans Products Co.

"Structural Materials for the Cargo Airplane"
H. D. Hoekstra, Civil Aeronautics Administration

"Airplane Design for Cargo Transportation"
Carlos Wood, Douglas Aircraft Corp.

CARGO GLIDER SESSION

Chairman: Charles P. Graddick, United Air Lines

"Air Pickup and Gliders as Related to the Future of Air Cargo"
Richard duPont, All American Aviation, Inc.

"Gliders for Transport"
Maj. L. B. Barringer, Chief, Glider Unit,
Directorate of Air Support, Army Air Forces

Air Transport's 'Elder Statesman'

SYMBOLIC to a high degree of the hard-headed, practical pioneering genius of American aviation that this month is helping to forge air cargo's future in Chicago is the career of William Bushnell Stout, toastmaster at the Air Cargo Engineering Dinner.

His first aviation lecture was delivered in 1907 to the Engineering Societies of Minneapolis and St. Paul, illustrated by slides furnished by Octave Chanute, early collaborator of the immortal Wright Brothers.

Aviation editor of the Chicago Tribune in 1911 . . . designer of the Scripps-Booth automobile of 1915 . . . chief engineer of Packard's aircraft division in 1917 . . . assistant to the chief engineer of the Army Air Corps in 1918 . . . builder, for the Navy, of the first all-metal plane in America, in 1922 . . . creator of the famed Ford Tri-Motor transport of 15 years ago . . . pioneer passenger transport operator . . . Mr. Stout is one of aviation's Elder Statesmen. His address to the Air Cargo Engineering meeting is scheduled for publication in next month's issue.

Gliders Plus Pick-ups As A Practical Air Cargo Formula for America

All American's Richard du Pont Painstakingly Analyzes What Can and Cannot Be Expected

By RICHARD C. DU PONT
President, All American Aviation Inc.

IT is a popular conception that the airplane, as typified by the modern airliner, is an extremely flexible instrument of transportation; and that it can fly anywhere subject only to the limitations imposed by fuel and the fact that it cannot be operated from a daisy patch. As the sky is trackless, this conception is perhaps natural and to a large degree it is true. Since the outbreak of the war, many of our commercial airliners have been mobilized and transplanted from their regular runs to military routes and missions that today are taking them to every part of the world. These aircraft are doing an incredible job and their swift transition from a peace to a war basis, which occurred almost overnight, is proof of the extraordinary flexibility of the airplane in these circumstances.

Nevertheless, the modern airliner is not as flexible as is commonly supposed, and its limitations become perceptible when it is flown in scheduled operations, particularly where the routes are relatively short and stops frequent. Here its versatility rapidly diminishes, and it is found that after all there are tracks in the sky—other than those established for safety's sake—to which it is geared, just as ground transportation is geared to rails and highways. These tracks have been largely created by the growing speed and size of the airplane itself.

In the evolution of our domestic air transportation system, the trend has been constantly toward bigger and faster airplanes. What the new industry had to offer the travelling and shipping public was speed. What the industry needed for economical operation and to place the cost of air transportation on a reasonable level was more payload.

These two forces, combined with keen competitive conditions in the industry itself, produced the modern air transport but in the process its flexibility steadily disappeared. The industry learned that the new aircraft could not be profitably operated over routes requiring stops at short intervals because *the time lost on the ground neutralized their greatest asset.* The industry also found that many airline cities did not have airports large enough to accommodate the bigger and faster ships while at others the traffic no longer justified the improved service. As a consequence, the domestic air transportation system began emerging largely as a high-speed *through* service between large metropolitan centers.

Take a look at the domestic air map today. Impressive? Yes, but a close examination reveals that actually it covers only 355 cities and this number includes the 115 communities that are on the Air Mail Pick-up system. Of the 240 designated stops on the trunk lines, many had been suspended even before the war either because their geographical proximity to other points on the same route made it im-

practicable to serve them or because their airports were inadequate. It might be said that these places have been by-passed by progress. In 1934, our airlines covered 178 cities. From the standpoint of service, expansion of the system to only 62 additional cities in eight years, which still leaves three-quarters of our population without the advantages of direct air transportation, is a feeble record of growth.

During the past few years, while the major airlines have been moving at an accelerated pace in the direction of long-haul transportation, much has been heard in the industry about the development of short-haul or feeder lines, but little was done about it in a constructive way until Congress itself took cognizance of the inadequacy of the airline system and authorized the Air Mail Pick-up routes. The subsequent success of these routes suddenly revived intense interest in the possibilities of short-haul lines.

The Air Pick-up system, which is conducted by All American Aviation, Inc., now operates in Pennsylvania, West Virginia, Kentucky, Ohio, New York and Delaware. Covering communities which range in population from 500 to 120,000 and which are an average distance of 18 miles apart, it constitutes a short-haul operation that a short time ago few in the airline industry visualized or thought could ever be practical or economical. No one was even dreaming of short-haul development scaled down to serving communities so close together, and it was more or less unthinkable that Air Mail Pick-up lines operating to crossroad towns, and depending chiefly on air mail for revenue, could ever prove more than an expensive venture of an indulgent Government.

The Air Mail Pick-up service was started by the Postoffice Department in 1939 as an experiment. A little over a year later it was placed on a permanent basis by the Civil Aeronautics Board. It has now been in operation more than three years. In that time, the air mail and express traffic has developed to a point where it is taxing the capacity of the fleet of single-engine Stinson SR-10C aircraft which were converted for pick-up operation. From the air mail revenues that the service is generating, the Postoffice Department is recovering its cost and perhaps making a modest profit.

Since 1918 when the air mail was first established, there have been only four years, and these all recent, when air mail receipts have exceeded Government payments to the air carriers. There are now in the files of the Civil Aeronautics Board applications for additional pick-up routes which would extend the service to 1400 more communities throughout the country. Unquestionably, a large part of the great expansion in air transportation that is anticipated after the war will be accomplished through the widespread establishment of Air Pick-up routes.

Five routes, varying in length from 178 miles to 316 miles, are embraced in the present Air Pick-up system. On the shortest route, there are 10 intermediate station points, or one for about every 18 miles. On the longest, there are 20 intermediate station points, or one for about every 15 miles. The daily schedules over all these lines are maintained at an average block-to-block speed of 110 miles an hour. At first it was 100 miles an hour, but it was afterward found that this speed could easily be stepped up to 110.

There is no doubt that Air Pick-up planes in the future will operate at much higher speeds as faster and more suitable pick-up planes are designed. The same forecast may be made about load limitations. The equipment now in commercial operation is designed to pick up a deadweight load of 50 lbs. However, in tests it has successfully picked up 125 lbs. and in daily operation it has picked up loads of from 60 to 100 lbs. without trouble, and equipment now in military use can pick up much heavier loads.

In the Air Pick-up system, flexibility and speed, factors indispensable to the success of short-haul air transportation, are combined in the airplane. It has literally brought air service within the reach of every hamlet in the country, something that never could be done by the conventional development.

Of what pertinency is all this to the future of gliders in commercial cargo operations? Of what relevancy to the subject are these comments on the shortcomings of our domestic air transportation system; the inflexibility of the modern airliner; the short-haul problem and the development of the Air Pick-Up system?

The answer is that the short-haul field, in my opinion, offers the best opportunity for commercial glider operations. In reaching this conclusion it has been necessary to examine the domestic air transportation system to de-

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termine what territory remains for the potential development of short-haul or feeder lines, the problems confronting this development, and whether such operations will pay. The inadequacy of our transport system reflects the need.

The Air Pick-up operation has proved that short-haul operations are both feasible and profitable. Further, it has demonstrated that flexibility of operation is essential to the success of short-haul routes. It would now seem that by employing the Air Pick-up by which gliders can be picked up and delivered in the same fashion that air mail and air express are handled today on the Air Pick-up lines, that we could provide, with flexibility, a much needed cubic capacity for greater payload.

The possibility of using gliders in commercial transport operations has been under study for some time by a cargo-conscious airline industry which is seeking the development of AIR FREIGHT as distinguished from air express. The industry realizes that to build up this traffic the ton-mile costs of air transportation must be drastically slashed, and that at present the airplane which will enable the industry to compete with surface carriers for this traffic on a cost basis is not in sight. The solution of the problem is more capacity and lower operating cost. As a means to this end, the glider attracted active interest which has been intensified by their spectacular success in transporting troops and war supplies.

At Crete, and in North Africa, it is known that the Germans used two types of gliders: one, capable of carrying 23 fully-equipped troops and two pilots or a freight load of 5300 lbs., and the other capable of carrying 10 troops and one pilot or a freight load of 2800 lbs. The freight capacity of the large glider is almost equivalent to that of a DC-3. These gliders were towed by a Junkers 52, a three-engine plane—general purpose transport and glider tug—which can carry a freight load of 4200 lbs. for a distance of 650 miles and has a cruising speed of 146 miles per hour.

It would seem logical that if the capacity of the airplane could be multiplied in transporting troops and military supplies by simply hitching on a glider, the same thing would be equally feasible in commercial operations. As the cost of the large glider probably would not be more than one-sixth that of the transport plane, this prospect held particular appeal. Among the more imaginative members of the aviation industry visions of great glider trains

streaking across the skies began to take form. A realistic appraisal, however, produces a more moderate picture.

The fundamental question is to what extent gliders can augment the transport plane. After careful study of the specifications of the Junkers 52, we can make the following analysis:

With a cruising speed of 146 miles per hour, operating at 60 per cent horsepower, the plane has a range of 650 miles. Fuel consumption is 120 gals. per hour. Using these figures, the weight of fuel consumption per mile is 4 lbs. Using these same figures we find that with a range of 500 miles, a cruising speed of 146 miles per hour, fuel consumption of 4 lbs. per mile, and with a crew of 600 lbs. and miscellaneous equipment of 400 lbs., and an empty weight of 14,300 lbs., we have a total of 15,300 lbs. With a gross weight of 22,000 lbs., we arrive at a net freight and fuel weight of 6700 lbs. Subtracting 2000 lbs. of fuel, we have a net freight weight of 4700 lbs. By the same method of computation, we also find that with fuel for only 250 miles we have a net freight weight of 5700 lbs.

German Model Hauls 2½ Tons

Now let's consider adding a glider such as the Gotha 242, for which the Junkers 52 has been reportedly used as a tug. We have seen pictures and drawings of this glider and know it is of only moderately clean design. Comparing this with other data available on the drag loads of gliders, I believe I am conservative in assuming that the effect of the additional drag of this glider on the Junkers 52 would not reduce the cruising speed of the combination to lower than 115 miles per hour, at the 60 per cent horsepower.

The Gotha 242 reputedly carries a payload of 5300 lbs. and with the cruising speed of the combination now reduced from 146 miles per hour to 115 miles per hour, we find that the gas consumption has been raised to 5.1 lbs. per mile. On a 500-mile basis, with a glider in tow, the plane will use 2540 lbs. of fuel, will carry 4150 lbs. net freight, plus 5300 lbs. of freight in the glider, making a total load carried of 9450 lbs. On a 250-mile basis, the plane will use 1270 lbs. of fuel, will carry 5430 lbs. net freight, plus 5300 lbs. of freight in the glider, making a total net freight of 10,730 lbs.

Reviewing the above, it would immediately appear that in the first case in a distance of 500 miles that *through adding the glider, we had increased the load carrying capacity of the plane by 4750 lbs. and in the second case for a distance of 250 miles, it had been increased by 5030 lbs.*

Looking at the entire question in another light, however, experience in carrying overloads in aircraft of this approximate size, indicates that it is not unreasonable frequently to run wing loadings as high as 30 lbs. per sq. ft. and power loadings upwards of 12 lbs. per h.p. Using the wing area and horsepower information on the Junkers 52, we could theoretically—by running the wing loading and the power loading up to these limits—run this airplane to a gross load of 29,000 lbs. In operating at a 29,000 lb. gross, I believe I am conservative in assuming the additional drag of the wing flying at a higher angle of attack would reduce the cruising speed at 60 per cent horsepower to not below 141 miles per hour, which figure when used would cause a fuel consumption of 4.2 lbs. per mile. Now, with an empty weight of 14,400 lbs. (100 lbs. added as structure to carry the overload), crew 600 lbs., and miscellaneous equipment of 400 lbs. giving us a total of 15,400 lbs., will leave us a net freight and fuel load of 13,600 lbs.

With fuel for 250 miles amounting to 1050 lbs., we now have a net freight weight of 12,550 lbs. With fuel for 500 miles amounting to 2100 lbs., we have a net freight weight of 11,500 lbs.

Plane Alone Carries More

Now, comparing this Junkers 52 in the 29,000 lbs. overload condition with the previous condition in which it was towing 5300 lbs. in the glider, we find that in a 500-mile range it could carry 2050 lbs. more payload, and in the 250-mile range—1820 lbs. more payload than the glider-tug combination. This illustration seems to offset practically all of the theoretical efficiency to be gained in towing the glider, but it may only open an argument as to why we cannot tow the glider with a tug loaded to 29,000 lbs. gross. It becomes obvious that such arguments become ridiculous after a point as more important factors will enter the picture, which will definitely limit the amount of load that can be carried in the airplane or in the airplane-glider combination.

We cannot arbitrarily state that gliders can or cannot improve the load carrying ability of any one plane by carrying more load in tow

than can be carried in the plane itself. This statement cannot be categorically supported because it all depends on what maximum overload the original carrier plane can be permitted to operate under, and such overload depends on the local conditions, the nature of the field, the altitude of the field, the weather and many other items.

It must not be overlooked, by those who believe that the use of gliders can improve the efficiency of a cargo operation, that the power required to carry the additional overload placed on a transport should be based only on overcoming the increased drag of the wings and only a very small increased drag on the fuselage, which power required would not be as great as the power required to overcome the entire drag of the glider. In other words, the additional load has not added to the size of the fuselage or the number of wheels, or the resistance of the windshield or the number of other items that have given the transport plane a much higher drag than the glider.

The principal expense of carrying an overload on a transport plane has to do principally with the L/D of the wing, which is expected would be at least slightly higher in efficiency than the L/D of an entire glider, designed to carry the amount of the overload.

I am not prepared to enter into the highly controversial questions involved as to whether the over-all efficiency would be greater in AIR FREIGHT operations if the cargo were distributed among gliders or confined to a single unit. I do, however, wish to point out clearly what in my opinion are the three most important advantages that can be obtained through the use of gliders when combined with the Air Pick-up.

When contemplating an air freight operation, when it seems desirable to overload an airplane the first question will be

1. *Are the runways where service is to be provided long enough to permit safe take-offs and landings?*
2. *Is the cubic capacity of the plane sufficient, and is it located in the proper place to provide proper balance?*
3. *Is the airplane strong enough to safely carry the overload?*

We can, of course, assume first of all in designing a cargo plane that it will be strong enough to support a certain maximum placarded overload condition, that the cubic capacity will be provided in proper places to carry a considerable load and that runways will be provided at communities that would justify a very heavy AIR FREIGHT traffic.

We must remember, however, that in filling these requirements, we are destroying flexibility and again creating tracks in the air that will prevent the public's receiving the full benefits of aviation. It must be remembered that in short haul cargo service, that planes must be unloaded and loaded at their intermediate points and that while the planes are being loaded and unloaded, they are not earning money. It must be remembered that heavy cargo cannot be loaded and unloaded as quickly as can passengers who can walk on and off the airplane without help and it must be remembered that adequate airports will have to be built for this type of cargo operation.

Flexibility All-Important

If the utmost flexibility is not provided, aviation cannot provide a complete public service. It is in meeting this public demand for flexibility that it would appear that the glider when combined with the extreme flexibility of the Air Pick-up can render its greatest service and can demonstrate the kind of efficiency and flexibility that has heretofore never been dreamed of in any kind of transportation. Namely, it could provide express and local service combined in one in such a way that cargo and passengers could be carried over a route on which service is rendered at numerous intermediate points, but where at the same time, each passenger and shipment will receive in effect, through service.

In the short-haul field, it is the scheduled speed of the operation and not the speed of the airplane that is of primary importance. For example, nothing is gained in operating an airplane which has a speed of 200 and 300 miles an hour at a given altitude if its speed is sabotaged by frequent stops.

Imagine how ridiculous it would be to take a large high-speed transport plane and attempt to operate it on a short-haul route such as an air Pick-up route. Imagine making 20 intermediate landings with such a plane on a 300-mile route, with 10 minutes' delay for each landing. In a case like that the flying speed of the airplane, no matter how high, would mean practically nothing as the block-to-block schedule speed would be reduced to the pace of surface transportation.

Now that we have more speed in airplanes

than can be economically used on the short haul, it is obvious that flexibility must be of foremost consideration. Flexibility means the ability to cut to a minimum delays at intermediate points and the ability to serve points that are close together. This flexibility has been achieved by means of the Air Pick-up.

Reference has been previously made as to how the value of speed in the transport plane is affected in scheduled operations by the length of the route and intermediate stops. From the airlines' schedules published in the *Official Aviation Guide*, I have tabulated a number of schedules selected at random which illustrates this point.

Route Mileage	*Intermediate Stops*	*Average Distance Between Stops (miles)*	*Elapsed Time*	*Scheduled Speed*
2,627	4	525 2/5	17:55	157 mph
1,307	4	261 2/5	8:45	149 mph
908	5	151 1/3	6:30	139 mph
570	4	114	5:17	108 mph
519	3	129 3/4	3:37	143 mph
476	2	158 2/3	3:23	140 mph
390	2	130	3:27	111 mph
359	2	119 2/3	3:12	112 mph
359	3	89 3/4	3:36	110 mph
219	2	73	2:00	110 mph
216	2	72	2:01	107 mph

A study of these operations—in all of which the aircraft used is a DC-3 which has a normal cruising speed of 180 miles an hour—discloses that on the longest route of 2627 miles having four intermediate stops an average distance of 525 miles apart, the schedule is maintained at an average speed of 157 miles an hour of 87.22 per cent of the cruising speed of the airplane. This differential becomes more pronounced as the routes become shorter and the distance between intermediate stops decreases. On the route of 1307 miles, having the same number of intermediate stops, which are separated by an average distance of 261 miles, the ratio drops to 82.78 per cent, and on the route of 908 miles with five intermediate stops, 151 miles apart, it declines to 77.22 per cent. On the eight remaining routes, all of which are under 600 miles in length and where the over-all average distance between stops is 111 miles, the ratio is 65.56 per cent for the group. Schedules on all Air Mail Pick-up routes are maintained at a speed of 110 miles an hour, or 89 per cent of the 125-mile-an-hour cruising speed of the single-engine pick-up planes.

The eight routes of less than 600 miles provide a cross-section of the range in which the flexibility of the glider could probably be most successfully employed in commercial operations. Proceeding on this assumption, let us set up a hypothetical cargo glider operation using a DC-3 airplane as a tug. Our imaginary route, taking round figures for convenience, would be 400 miles long and have three intermediate stops an average distance of 100 miles apart. Applying the speed index of 65.56 per cent which it has been found is the average differential between scheduled speed and the cruising speed of the aircraft on routes of this length, the scheduled speed of an airplane flying alone over this route would be 118 miles an hour.

Now we hitch on the glider or, in this case, it will be a formation of three gliders, one for each intermediate point. Through cargo will be stowed in the tug. The combined capacity of the gliders will be equivalent to the payload of the airplane. We will assume that the addition of the gliders will reduce the cruising speed of the tug about 25 per cent as a conservative estimate, or to 135 miles an hour using a DC-3. This assumes the use of gliders of only moderately clean design with wing-loadings that will enable them to land at speeds between 45 and 50 miles an hour. If the gliders were of cleaner design and the landing speeds allowed to run higher the cruising speed of the tug might not be reduced below 145 miles an hour. Using the 135-mile-per-hour figure, making the flight without landing and dropping gliders off at each intermediate point, we could conservatively assume a block-to-block schedule speed of at least 120 miles per hour, or 89 per cent of the 135 miles per hour.

I am conservative, I am sure, on this schedule speed as experience in non-stop pick-up operation shows that we can keep schedules at 89 per cent of a lower cruising speed where adverse winds will cause a greater difference between cruising speed and schedule speed. And this does not allow for any accumulated improvement in cruising speed resulting from dropping off the drag of a glider at each intermediate point. If, however, we were to make a landing at each point in order to exchange gliders, I am sure I would be equally conservative in predicting that the schedule speed would be reduced to a figure not higher than 105 miles per hour, which figure can be arrived at by simply subtracting from the previous 120 miles per hour non-stop schedule speed, the effect of 10 minutes on the ground at each intermediate point. This time represents the usual schedule allowance for intermediate landings using DC-3 equipment, and does not attempt to make allowance for any additional delays that may be caused by handling gliders.

If we consider the problems involved in moving the gliders into take-off position and in attaching each to the tug at each of these intermediate points, it would not be difficult to imagine how the time lost at each point could reduce the block-to-block schedule speed to a point where the value of the service would be completely destroyed. Moreover, the size of the airports necessary to conduct such an operation would certainly confine the service to only the larger cities.

Pick-up Makes Difference

It is apparent that a non-stop operation, in which a glider is cut loose at each intermediate point, would be considerably more feasible, but it would be limited by its inability to render service between intermediate points and terminals. The maximum load-carrying ability of the formation could not be utilized over the entire route and the problem of retrieving the gliders and returning them to terminals would still remain.

With the application of the Air Pick-up principle, however, our cargo glider operation begins to assume more practical aspects. The pick-up gives it the combination of speed and flexibility which are the primary requirements of short-haul transportation. With respect to the speed factor, it already has been shown that on present Air Pick-up routes the scheduled speed is 89 per cent of the cruising speed of the aircraft. Applying this ratio to the cruising speed of a DC-3 with gliders attached which has been estimated at 135 miles an hour, we could maintain a scheduled speed of 120 miles an hour over our hypothetical route in a straight pick-up operation. This would be at least 15 miles an hour faster than the glider-tow operation previously described, and still 2 miles an hour faster than the average schedule speed now maintained by DC-3s over a route of this sort.

One Glider Per Stop

On glider pick-up routes where there is more than one intermediate stop, it will be necessary, of course, to operate glider formations composed of one for each intermediate point. Our hypothetical route would require a tug and three gliders. At each on-route point a glider would be delivered and another picked up which would give these places service both to and from terminals, something that would not be possible otherwise, unless landings were made. Use of more than one glider should not materially affect the schedule speed of the operation. The frequency of pick-ups causes little or no delay. Experience in Air Pick-up operations to date has shown that pick-ups can be made at speeds substantially above that of the cruising speed of the airplane, as in tests pick-ups have been made at ground speeds as high as 160 miles per hour. There appears to be no immediate limit to the speed at which pick-ups can be made, nor does there appear to be any immediate limit to the size of tug and gliders used for such operations. Furthermore, glider pick-up experiments already have demonstrated that little or no more delay is required for a glider pick-up than for a mail pick-up.

In recent tests, eight consecutive glider pick-ups were made at intervals of every 4 minutes using the same glider and the same pick-up tug. On Air Pick-up routes, stations are installed as nearly as possible in the line of direct flight, and experience has likewise shown that no deviation from course is necessary even with a downwind component as much as 20 miles an hour. If conditions are encountered where the downwind component is in excess of 20 miles an hour, pick-up pilots prefer to make the pick-up in the opposite direction "S'ing" through the station. Although the maneuver necessitates a complete reversal in direction and a turn back on

course, it is found that the time lost in making it is easily regained while flying between stations through the additional speed supplied by the tailwind component.

One of the outstanding features of the glider for military purposes, and one of the outstanding safety factors in operating motorless craft, is the fact that it can be landed in areas many times smaller than an airplane of equivalent capacity. Through the employment of the Air Pick-up system it can now be retrieved by air from similar areas which ordinarily would make it necessary to dismantle the craft. This advantage means that the size of local airports need not restrict the scope of glider pick-up service in scheduled operations as it does now in trunk line operations. When more efficient tug and glider combinations have been designed and more experience gained in the operation of glider formations or trains, we undoubtedly will find it possible to tow a relatively large number of gliders by a single tug which will still further increase the flexibiity of the glider pick-up system allowing greater intensification of this type of service.

There are those who believe that glider operations will never be practical commercially because of problems concerned with take-off, rough weather, blind flying and similar difficulties. This theory reflects the philosophy which for years has been retarding the development of aviation, and I must express complete disagreement with it. With respect to these particular problems, substantial progress has already been made in meeting them.

Problems relative to take-off already have been practically eliminated by the adaptation of the Air Pick-up system to launch gliders. The Germans have used rockets for this purpose. Rough air operations have been practically corrected by the use of special tow lines and special shock-absorbing equipment. Problems involved in blind flying are being worked on and have already been practically eliminated through special blind flight instruments. It is a safe prediction that if a progressively constructive attitude is taken toward the solution of these problems, they will be solved and solved quickly.

While it appears that the glider may have its most important commercial application in the further development of short-haul air transportation, recalling again that the term "short-haul" is purely relative, it must be appreciated that we are entering a new field in aviation which remains to be fully explored. What we learn as we progress may change our whole concept of the future, but regardless of what happens it is essential that we approach this new problem with an open mind. We should not discard new ideas just because they seem fanciful in the light of experience or because without proper analysis they may on the surface appear to have no practical adaptation. Many things in aviation which are commonplace today were once regarded as the dreams of visionaries. The unwillingness to accept new ideas has had a restricting influence on the advancement of aviation in the past, which has already cost us dearly. Never again must we permit an over-conservative influence to retard developments in aviation as they have done. Let's develop to the utmost the possibilities that will give aviation what is demanded of it by the public, which is the greatest possible flexibility combined with the ability to carry bigger payloads more efficiently.

WANTED

EXPERIENCES—Have you transported much material by air? What have been your experiences? When and how was the use of air transportation a distinct advantage? Have you made any unusual shipments? Any requiring unusual preparation? If so—tell us—so we may tell others through the columns of this publication.

IDEAS—We are not seeking inventions—just ideas, such as loading and unloading cargo planes—loading platforms—improvements for Air Terminal facilities—trucks—stowing, etc. If you have any suggestions, let us pass them along.—*The Editors.*

40 Per Cent of Army's LCL Cargo Moving by Air

Striking Picture of Achievement Painted by Cargo Equipment Maker Before SAE's Gathering

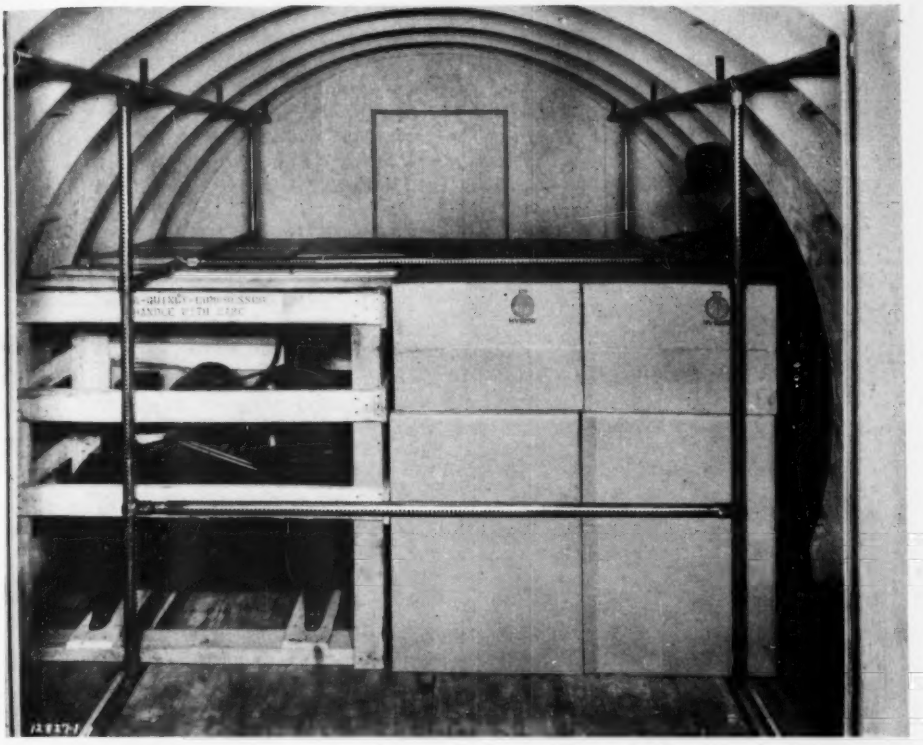
By COLONEL EDWARD S. EVANS
President, Evans Products Co.

AIR transportation of freight is today a reality. Forty per cent of all l.c.l. shipments made by the Army is made in airplanes. I need not tell you that the major part of freight sent to such out-of-the-way places as Iceland and Alaska is moving by air. The air transport from India to China, conveying supplies to Chungking, is moving larger quantities of freight than did the 4,550 trucks on the Burma Road. Just what is being carried to England by the bomber ferry is the Army's secret.

In spite of the above facts, there has been up until now no scientific method of shoring and stowing cargo in freight planes. This is not at all surprising because I can remember some 27 years ago, when I was carrying on a series of experiments which led to the adoption of scientific methods for the loading of automobiles, that automobile engineers would not even consider their loading problems. They were too engrossed in design and all of the difficulties of giving birth to that great industry.

When the matter was raised, I was referred to the loading foreman on the dock and these men each had their own individual ideas, none of which were based on scientific research, with the result that there were 18 distinct methods of loading automobiles in force in 1915. This held true for a number of years after that until, through constant urgings and some education, the automobile engineers commenced to take an interest in the car after it was built to see that it arrived safely at its ultimate destination.

It was in those early days that, carrying on a series of intensive scientific experiments, I laid the foundation for the adoption of loading methods for automobiles which has since that time reduced damage claims from $5 per automobile to 8 cents per automobile and which, in addition to about 300 million dollars saved the railroads, has saved the automobile com-



***SECTION OF LOAD** in a full scale model of an air-cargo plane. Evans equipment shown here is designed as permanent installation for ships. The two longitudinal members attached to the ribs above and the two longitudinal members in the floor attached to the floor posts are fixed. The other members shown, including the vertical members, the cross members, and the longitudinal members between the two vertical posts, are all removable, adjustable at ½" intervals, and interchangeable. This view shows one cross member on top of the load to hold it in place, a second cross member across front of the load, serving as a bulkhead.*

panies and dealers another 300 million dollars.

The loading of various commodities in box cars is supposed to be regulated by rules published by the Association of American Railroads and sponsored by a Loading Rules Committee, but to an engineer some of these rules guarantee not safety to the cargo but damage to the cargo and show an astonishing lack of scientific knowledge of the problem which would, on the face of it, seem to be a simple one. As an illustration of what I mean, a load of linoleum was fastened in a box car with the Evans Utility Loader and arrived in perfect condition; a similar load made in accordance with the loading rules of the Association of American Railroads in which the cargo was fastened with band iron suffered considerable damage. Hot rolled band iron will stretch 15 per cent before it fractures. Therefore, a cargo stowed in one end of the freight car with band iron, each piece of which is about 20 feet long, is susceptible of stretching about three feet.

I found in tests made with automobiles, in which we used three freight cars, on the middle one of which we placed an automobile fastened to a dynamometer, that where the loading blocks were pressed tightly against the wheels we got entirely different results from where they were pulled back a half inch. Where the blocks were drawn back from the tires and the car shunted into other freight cars, the blow exerted on the blocks and on the dynamometer was four times as great as it was when the blocks were fitted snugly to the contour of the tires. Therefore, we were

able to evolve certain principles in loading which later experiences developed to a point where they became the fixed formula.

We find that in freight cars practically all damage is caused by one of two things. Either vertical vibration, which at its extreme is called harmonics, or longitudinal shock. This is of interest to you only because millions of dollars worth of airplane parts are shipped in freight cars and, whereas it has no direct bearing on airplane cargo loading, it is nevertheless important that we get a grasp of the broader problem before applying it to the specific question under discussion. Whether a load is made in a freight car, in a truck trailer, or in an airplane, there are certain basic rules which have to be followed. The prime rule is that there must be no slack in the load. If the load can move, immediately its own momentum will set up stresses and shocks which will enable it to break its moorings, shift center of gravity, and do many other dangerous things.

In most instances, cargo carriers today in the air are converted passenger transports or bombers, and no provision of a permanent character has been made for cargo shipment. The very nature of the structure of an airplane is such that it is difficult to fasten heavy objects in such a way that they will not tear through the aluminum sheeting, and so the engineering of airplane loading offers difficulties that are foreign to loads in freight cars or truck trailers. However, where transports are originally designed and built for freight transport, this is no longer true. Strong, se-

ANOTHER TYPE of air cargo hold-down equipment designed by Evans and now in actual air freight service. This picture shows the use of two separate methods, both developed by Evans. One, shown in the load on the left half of the plane, consists of rope, hooks and rope tighteners. Portion of the load on the right shows method which consists of tubes with hooks in one end for attaching in floor or walls of plane, and twin wooden cross members which can be tightened down on the tube to act as a transverse bar to any vertical movement.

curely fastened loader parts can be incorporated into the design of the ship so that hold-down members of various types can be attached without danger of injury to the hull of the ship itself, and individual commodities of considerable weight, such as airplane engines, reels of cable, large machine tools, etc., can be loaded with perfect safety and security.

The one thing that the loading engineer has to consider as the prime factor of airplanes is weight. In a box car we put equipment that weighs 9,000 lbs. In a plane, carrying almost as large a load, the equipment will weigh less than three per cent of this amount, or a maximum of less than 300 lbs.; and in such planes as are ferrying freight to Alaska, the loading material used for fastening down a whole cargo is about 100 lbs. Therefore, the greatest care in design to accomplish lightness, and at the same time ample strength, has to be employed. Materials must be used that will insure a tight and resilient fastening and that will not stretch under impact. It is not unusual for a down draft to be violent enough to lift the entire cargo so that it will exert an upward strain of 2.4 times its own weight. If the cargo is not held securely and the plane should wobble, the whole cargo could be thrown off center and the center of gravity changed so that the plane would crash.

Airplane efficiency can be greatly increased if proper loading is practiced. For instance, there are many objects that are shipped in airplanes today where the box weighs as much or more than the article it contains. Crates and boxes are often bulky and unnecessarily heavy. If proper loading materials are used, the weight and space occupied by heavy crates and boxes can be replaced with unboxed or very lightly boxed commodities and the payload greatly increased. Proper loading materials will accomplish this safely and quickly.

An excellent illustration of what I mean is a load of airplane engines shipped in box cars. I use this only as an illustration, but it will relate in a lesser degree to airplane engines and other parts shipped in air freight transports.

Until recently, the airplane engine manufacturers were purchasing heavy wooden crates weighing hundreds of pounds and costing $77 for the shipment of their engines. A box car load consisted of 7 engines, and this box car only carried a payload one way, being shipped back with empty boxes where same could be salvaged. A load made in an Evans Utility Loader, which is similar in its functions to the materials that we furnish for airplane cargo, took 14 engines and eliminated the cost of $77 per crate, the freight on 12,600 lbs. of boxes, and the labor of boxing and unboxing the load at the two ends of the trip. The saving showed $1,176 per trip, and in view of the fact that it is expected that we will ship many thousands of engines a month in 1943, there would be a saving of approximately $2,525,000 a month which is now waste.

The same general rules hold as true with air freight as they do with box-car freight, and a study of the various loads now being made will probably disclose many ways that the vital things shipped can be increased at the expense of unnecessary dunnage.

If you know that each part of the cargo will be held firmly and securely in place and will have no chance to bruise or injure itself by hammering or rubbing, you can safely lighten the packing and crating accordingly.

I am showing a few pictures to illustrate the methods which we have introduced in the loading of airplane cargoes. Most of these devices have been designed to be used in converted planes built originally for some other purpose and, therefore, they are more or less makeshifts as compared to what the final hold-down or loading device will be. . . .

These types of air cargo loading devices are not purely theoretical designs, but have been proved thoroughly practical and efficient in actual air freight services.

Air Transport Makes It From Australia to U. S. In Less Than 36 Hours

A foretaste of the sort of air cargo shipping schedules which peace will bring was given last month when one of the big Army transport planes already in production (*see* AIR TRANSPORTATION *for October*) set an Australia to California record of 35 hours and 53 minutes.

The record-breaking craft was a Consolidated C-87, transport version of the famed Consolidated Liberator bomber. Occasion was the return from Brisbane to San Francisco of Lieut. Gen. Henry H. Arnold, chief of the Army Air Force, from a 22,000-mile tour of the South Pacific war zones. Later the plane and its high-ranking passenger flew on to Washington, where General Arnold received a Distinguished Service Medal.

New Plane Types Needed For Cargo Success: A Dual Report: I

By CHARLES FROESCH
Chief Engineer, Eastern Air Lines Inc.

ONLY ten months have elapsed since the airlines of the U. S. were called upon to begin the transportation of cargo on a large scale for the Military Services. The volume of cargo so far flown and its rate of daily increase have presented cargo handling and transporting problems which must be satisfactorily solved before air cargo transportation can become a routine operation.

Expedient solutions are meeting the present emergency but fundamental thinking and reasoning must be followed to derive specifications applying to cargo airplanes in order to establish the transportation of air express and air freight as a commercial business at the termination of the war.

Flying has become an accepted means of transportation by the commercial traveler as well as the vacationist, but the carriage of goods by air has lagged, primarily because of the lack of suitable flying equipment and handling facilities. Furthermore, the relatively small amount of space available for air cargo has been indirectly the cause for the existing high tariffs which, in most instances, have been higher per pound per mile than comparative passenger rates.

When it became obvious at the beginning of this war that speed of transportation for critical military materiel was essential, it was logical that available passenger equipment in use, or already designed and ready to be produced, should be quickly altered to meet this immediate demand.

Airline equipment was pressed into cargo operating service literally overnight, speedily converted for such service by removal of passenger accommodations, strengthening floors with additional covering and changing radio equipment to meet military requirements.

This conversion was effective, although rather inefficient insofar as maximum ratio of useful load to gross weight is concerned. But this was partly offset by lifting commercial weight restrictions and increasing takeoff weights in the order of 20 per cent with surprisingly safe and reliable results, which incidentally, emphasizes the conservativeness of commercial equipment maximum operating weight ratings.

The standard Lockheed Lodestar and Douglas DC-2 and DC-3 transport planes were thus modified and are doing an excellent job. Later on, production of the C-47, basically a DC-3 having a large side loading door; the C-46, modification of the original 36-passenger Curtiss-Wright CW-20 commercial transport; and the C 54, conversion of the DC-4, swelled the ranks of cargo planes to expedite movements of military personnel and materiel. A more recent modification was that of the Consolidated B-24 four-engine bomber to long range cargo carrier—the C-87. . . .

No one knew just what a cargo airplane ought to be and with limited airline experience in cargo operation, much difference of opinion still prevails on the design of this type of plane. However, we are fortunate to be in the same position as the beginner photographer who is proverbially taught how to take bad pictures in order to learn how to take good ones. . . .

1. The conventional landing gear renders loading of the cargo compartment with heavy cargo difficult because of the floor gradient. This is aggravated by the lack of anchor points for hoist attachment to help pull heavy items at the entrance door or in the cabin. . . .

2. The standard passenger cabin floors are too weak to stand concentrated loads as well as the rough usage to which they are sub-

jected as cargo carriers. This has demanded reinforcement by either strengthening the present floor structure or covering it with an additional floor. This supplemental floor consisted generally of plywood sheeting ⅜ in. to ¾ in. thick and has been found quite serviceable though it substantially increased the empty weight.

3. In the converted airliners, the cabin entrance door is too narrow and too low to take the bulkier cargo pieces. This seriously impedes efficient loading and unloading and limits the size of pieces which can be handled. This is an important item when it is considered that the size of cargo pieces may commonly run from an article so small as to require wrapping its shipping label around it instead of pasting it, to automotive units measuring almost 13 ft. in length, 6½ ft. in width, 4½ ft. in height and weighing 2500 lbs. Occasional loads either have greater dimensions and/or weight. It would be desirable to have an additional door, located opposite, to enable simultaneous loading and unloading and thus save time on the ground, particularly when one or two pieces of a load are difficult to handle, either due to size or weight.

4. When we have placed the cargo within the airplane in its proper location, no means are available to anchor the tie-down cables, ropes or other devices used and a makeshift installation must be provided.

Each type of cargo presents a somewhat different problem in tie-down procedure. Methods of tie-down vary with individual airline interpretation due to lack of basic provision in the airplanes. Some airplanes have ring tie-down fasteners attached to the floor frames, others have side rails and still others employ a combination of both means. The most common practice is to use ropes tied in an indiscriminate manner, usually following the fancy of the handler lashing the cargo. Nets are used but need frequent replacement. . . .

5. No provisions are readily available for a cargo handler station.

6. We find a lack of simple and concise information to permit the loading personnel accurately to distribute the cargo load within the prescribed balance limits. In addition, it is often difficult to place heavy pieces within the cabin and still retain a center of gravity location which will not seriously affect longitudinal stability as well as take-off and landing characteristics.

For instance, when a load of 6000 lbs. is carried in the C-49, its CG must be at a point roughly 28 per cent of the cabin length from the forward cabin wall. This seriously limits the available placement volume if the cargo is bulky.

The arrangement of cargo is at best a process requiring intelligent action in view of the variable weight, size and type of cargo pieces, besides the fact that such cargo may be bound for several destinations requiring placement in the compartment to allow sequence unloading.

7. The lavatory compartment is in the wrong place as it is often difficult, in flight, to reach it from the pilot's cockpit with a plane fully loaded with bulky materiel of low density.

8. No provisions are available for fire-detecting and extinguishing in the passenger cabin converted to cargo compartment as hand fire extinguishers are the only requirements for passenger operation.

9. Each type of plane has a different door-sill-to-ground height, necessitating lifting or lowering the cargo when loading from a standard motor truck platform height. This has resulted in serious delays, trip cancellations and inability to operate on schedule. For instance, the doorsill height from the ground is but 3 ft. 6 in. for the C-87, whereas it is 9 ft. 8 in. for the C-54, or a difference of 6 ft. 2 in. between the two. . . .

10. The cross-section of the fuselage, usually of circular or oval shape, does not permit maximum space utilization.

These are ten primary deficiencies found in the operation of converted passenger transport airplanes for air cargo service as well as in planes originally designed for passenger operation and factory-modernized for cargo.

While our primary purpose now is to win the war, we must nevertheless look deeper and make plans for the future. Whatever changes are made will also apply to military cargo planes with the exception, perhaps, of speed, which for military purposes must remain more important than operating cost.

In thinking of the progress of air transportation, we must try to find its proper relationship with available surface means. Obviously, we cannot hope to fly every traveler and carry

every type of merchandise with maximum economy and must therefore segregate passengers and cargo according to purpose and distance of travel.

Before we can tentatively set down operating requirements for airplanes designed basically for commercial air cargo operation, we must first determine just what are the fundamental laws which apply to transportation of air cargo.

The principal service the air cargo operator has to offer to the shopper is the speedy and safe transportation of his products. He must furnish this service at a sufficiently low tariff to attract and continue to carry a large volume of traffic. Air express volume has been built in the past primarily on the demand for emergency and perishable shipments which could bear a rate premium and as such can never grow to a substantial size.

Our first consideration, therefore, should be lowest possible operating cost per ton mile. This is a necessity if we desire to obtain a large volume of business and compete with other means of express and freight transport which now have substantially lower rates per ton mile from door to door than we have been able to obtain with the airplane to date.

First-class rail express is moved at a cost to the shipper at an average of 10 to 12 cents per ton-mile and, if this rate can be met, including pickup and delivery cost, there should be a large volume of business available for movement by air and including most commodities which now go by rail express.

We certainly cannot hope—nor expect—to supplant existing means of surface transport, as at one time or another in the course of modern processing or fabrication of commodities or articles, practically all such means are utilized. The plane will probably limit its service to transportation of merchandise representing either a high density or volume cost such as expensive tools and vacuum tubes, thus becoming intermediate means of carrying finished products from factory to consumer with maximum expediency.

A 10- to 12-cent per ton-mile rate is not impossible if we judiciously interpret and apply our present knowledge of aerodynamics, improvements in structures and larger power plants to the design of strictly cargo carrying airplanes.

It is true that mileage from point to point is invariably lower by air and that the elimination of heavy packaging decreases cost of cargo preparation and promotes efficient utilization of the airplane. But these advantages come far short of overcoming the differential between air and rail express tariffs.

We can possibly go further by exploring the field of l.c.l. freight which might possibly be handled as second-class or deferred express, bearing a lower rate and used to increase the average load factor, thus reducing average ton-mile-per-hour cost.

Later we may conceive the use of cargo glider trains with takeoff and landing strips alongside factories simulating present railroad sidings. However, this discussion is limited to operating requirements of cargo airplanes only.

A cargo airplane should be a vehicle to carry merchandise not only at the lowest possible cost, but at the highest permissible speed. High speed is essential but if it is to be obtained purely by a reduction in cruising power loading, operating costs will be higher, since speed varies as the cube root to the horsepower. This being the case, tariffs would have to be raised and volume obtainable lowered.

For a given airplane, designed for a specific gross weight, and having a given wing loading, there is a power loading which is most economical. In other words, there is a balance between maximum payload and lowest cruising horsepower on one hand, and low power loading with reduced payload on the other.

This can be readily determined with a given airplane by calculating its transportation efficiency factor expressed in ton-miles-horsepower-hour for several horsepower values, that is:

$$\frac{Pl \times Vc}{HPc}$$

Where Pl = *payload in tons*
Vc = *cruising speed in m.p.h.*
Hpc = *cruising horsepower*

The overall efficiency factor of the airplane can be obtained by multiplying the structural efficiency expressed by

$$\frac{\textit{operational useful load}}{\textit{gross weight}}$$

by the aerodynamic as expressed by

$$\frac{\textit{cruising speed}}{Hp}$$

and plotting against range.

Obviously, there is nothing to be gained if due to high speed the cargo must wait several hours to be unloaded at destination, such as might occur with a load of perishables having left the field of origin the evening before and arrived at destination several hours ahead of customary delivery time.

I fear to tread on the question of airplane size, except to mention that it must be remembered that larger airplanes permit higher ratios of useful load to gross weight and also greater range for a given load, as many airplane components and detail weights do not increase proportionately to the gross weight. Airplane size at present is limited by available engines, although this existing restriction may be reversed with the conception of large airplanes requiring several years to design and fabricate experimental prototypes. As a matter of fact, engines will need to be conceived and developed to permit lower fuel cost per-ton-mile and more miles per gallon or else air cargo expansion may find itself seriously curtailed, especially for long range operation.

Market Must Be Analyzed

Cargo airplane size and capacity cannot be predicated until a thorough analysis of the air express and freight market has been made. All we know is that air express is here to stay and that its volume will depend on the cost of the service to the shipper. Also, that air freight will follow on the wake of any rate reduction which can be made to render its transportation competitive with other means.

Obviously, the sales price of any cargo airplane must be as low as possible because on the basis of modern experience, depreciation amounts to, roughly, 10 per cent of direct flight costs.

Generally speaking, the type of cargo airplane which appears most suitable points to a high wing bimotor with tricycle gear. For larger capacities and longer range, a four-engine low wing might be considered superior.

Because of its simplicity, the bimotor type is more economical and meets the most important operating requirements for the following reasons:

1) It has the simplest power plant combination and meets the requirement for safe operation and reliability with least servicing and maintenance. Single engine performance must be sufficient to maintain a safe altitude over the highest obstacle to be negotiated.

2) A high wing combination permits low fuselage and, therefore, low door height to ground, besides having ample wing-to-ground clearance to allow freedom of movement for ground vehicles without danger of hitting the wing. Furthermore, large propellers may make a high wing or mid-wing location almost mandatory for any cargo airplane up to a given size.

3) The use of a tricycle landing gear is necessary to obtain a level loading floor and ease of loading and unloading.

In practically all landings, the pilot usually flares the airplane more than is necessary, with resultant higher vertical velocity upon impact on the runway unless lift is retained by high landing speed.

From an operational viewpoint, the elimination of the landing flareout necessary with the conventional type of landing gear is an advantage as with instrument landing in bad weather the airplane must be virtually flown to the ground.

One of the basic characteristics of cargo airplanes should be the largest possible center of gravity travel to eliminate critical load distribution.

The cross-section of the cargo compartment should be square or rectangular in section for maximum space utilization and cargo hold-down anchor location simplification. There should be no sharp corners which might be a source of personnel hazard, besides being dirt collectors. The minimum height of the compartment should be 6 ft. 6 in. to allow walking throughout its entire length erectly.

Doors for Loading Vital

There should be at least one large loading door on the left side, together with a smaller side one for crew entrance and exit at the front end of the same side. Preferably, and I repeat what I mentioned earlier, another large loading door should be located on the opposite side somewhat ahead of the left loading door to enable loading and unloading at the same time.

The doors should be designed to present minimum obstruction to loading and unloading. Flush mounted sliding doors would best meet this requirement.

Cargo compartment floors should be on the same level to expedite loading and eliminate steps as a source of accidents. Such flooring should be of sufficient strength to take a high load concentration and the entrance door region should be designed to take a load concentration equal to the heaviest piece expected to be carried. This may require a good guess as about 90 per cent of all express packages are shipped in corrugated boxes or light wooden crates which can be carried by one man. However, the remaining 10 per cent may include aircraft engines weighing up to 3500 or 4000 lbs. as well as other pieces of heavy machinery which have been carried in the past as emergency shipments.

From the economic point of view it does not appear logical to increase the empty weight of every cargo airplane of a fleet to handle this 10 per cent of cargo and the solution may be that only a few such cargo airplanes will be sufficiently strengthened to take what is virtually heavy freight.

Cargo space volume for any given airplane size should be based on an average express or freight density.

Rail freight averages 32 lbs. per cu. ft. and rail express about 12 lbs. per cu. ft., while airmail averages 9 lbs. per cu. ft. If we assume that improvements in packaging can reduce express tare 20 per cent, we arrive at an air express density of approximately 9½ lbs. per cu. ft.

Allowing for unusable space plus a certain amount of space in the region of the loading door which should probably be kept clear at all times, we can set down a density volume ratio of 8 to 9 lbs. per cu. ft. as design criterion in determining the size of the cargo compartment.

Cargo stowage means should be light and efficient, suitable cargo tiedown devices should be provided flush-mounted and built integrally with the floor and side wall structures. Provisions should be made for a flexible segregation of the cargo compartment space into bins and sections, such as may be obtained by the use of movable stanchions with flexible partitions such as chain doors, which are light.

The entire cargo compartment should be well-ventilated without being drafty. Heating should be provided in the design to maintain a 50°F. temperature which is necessary when perishables such as flowers, fruits and animals are to be transported.

It will be necessary when operating in cold climates to provide temperature insulation and such insulation should be made readily removable for two reasons: weight-saving when not needed and to allow cleaning. Provisions should be made for air-conditioning and possibly refrigerating.

Cockpit arrangement should include space for cargo handler station. The cargo handler's duties would be to keep track of all cargo pieces, check and prepare cargo manifest, check destination of cargo, supervise loading and unloading, check the CG location of the cargo for balance, as well as any other "in flight" duties which may be required.

A small cargo compartment should be provided and readily accessible from the cockpit for the safekeeping of valuables.

Power plant assemblies must be designed so as to be quickly changed. This is a most desirable feature which has been lacking on all transport airplanes designed to date. . . .

In other words, the plane should be designed so preventive maintenance and service methods can be best applied.

In order to simplify ground handling of cargo prior to loading or unloading, and gain a saving of ground time and labor, I would like to enter a plea for standardization of cargo loading-door to ground height, possibly door size, cargo tie-down equipment within the cabin itself, and containers for the collective handling of small shipments, as it is not believed possible to standardize to any great extent on package size, except perhaps on the type and materials used in packaging in order to reduce tare, which represents a high percentage of the total weight of the article being shipped. This is an important item which needs emphasis and will require an intelligent and imaginative study when it is considered that at present approximately 30 per cent of the weight of express shipments is packaging.

The development of air cargo will serve to accelerate the distribution of national and international wealth and promote similar commerce. It will allow greater enjoyment of the material wealth of the earth and it is hoped will also serve to eliminate intercontinental friction which since the world began has been the source of destructive warfare. This may be an idealistic goal, but it is my belief that the airplane, as a vehicle of speedy transport, can make it real.

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New Plane Types Needed For Cargo Success: A Dual Report: II

By CARLOS WOOD
Proposals Engineer, Douglas Aircraft Corp.

TRANSPORTATION has had an extremely important effect on all of world history. Available means of transportation have always tended to control the radius and magnitude of activities, peaceful or military. This controlling effect has been very powerful, as any critical review of history will show.

The type and scope of transportation is divided into two definite classes that are directly linked with man's technological development:

1. *Pre-industrial revolution*
2. *Post-industrial revolution*

The first class depended on animal power of some type and was thus limited in radius and magnitude by that fact. Radius of operation depended on the availability of refueling stations—pasture, grain and other food. Magnitude of operation depended on the availability of animals and conveyances of suitable types and numbers. The animals were the results of animal husbandry, the conveyances were the result of technology and artisanship.

The second class is distinguished by the continually decreasing dependency on animal power and increasing dependency on mechanical power. Radius of operation still depends on the availability of refueling stations, now purveying mineral fuels suitable for use in the available sources of mechanical power. Food is still necessary but is no longer the only necessity. Magnitude of operation now depends on the availability of sources of mechanical power and conveyances of suitable types and numbers. Both the power sources and the conveyances are now the result of technology and artisanship.

Railway transportation development was tremendously accelerated by our own Civil War because of the growing necessity of transporting increasing quantities of men and materiel with speed and dependability. The military lessons were well read by foreign observers with the result of practically immediate military victories in Europe. During the ensuing years commercial railways expanded tremendously, being the basic means of transportation by the time of World War I.

World War I eventually found that railroads alone were not sufficient, and finally used large numbers of motor trucks in transportation of men and materiel. A few airplanes were used for transportation of materiel—bombers began to appear near the end of the war. During the ensuing years commercial trucking expanded tremendously, becoming a major means of transportation by the time of World War II. Air transportation expanded to an extent of being useful by the time of World War II.

World War II has found that railroads, trucks and ships are no longer sufficient, and has begun to force development and construction of large numbers of cargo-carrying airplanes. In the light of past history and experience we feel that it is safe to expect a major expansion in the post-war use of airplanes for the transportation of passengers and cargo.

As a result, it appears that the time has arrived for dispassionate discussion of the design of airplanes for cargo transportation. It is still not too late for the results of such analysis to be useful toward winning this war. It is now time to investigate the bases of economical operation of cargo airplanes that will go far toward winning the peace.

Military operations are normally controlled by an economy of scarcity. Some things are always near a minimum of safe quantity in any campaign. The main enemies behind our own lines are time and distance. For any given unit of transportation the utility can be expressed as the ability to transport a certain

amount of *pound-miles per hour* of men or materiel. As a result, the airplane that will transport the largest number of pounds at the highest block-to-block speed for any given range will be the most useful.

The availability in numbers of airplanes comparable with the man-hours to produce those airplanes may be best expressed by the airplane's weight empty as man-hours for production have been found to be essentially a function of the weight empty.

It is suggested that the utility of the airplane may in many cases be affected by the landing distance or the takeoff distance as these distances will have an effect on the man-hours necessary to build and maintain any usable operating bases. The landing distance varies approximately with the square of the landing speed. The takeoff distance is a function of the landing speed and the power loading.

* * *

Any successful airplane must be designed for the job it has to do. Any good cargo plane must be built around the cargo compartment. The compartment must be large enough to contain the cargo and must be properly located with respect to the remainder of the airplane to allow its use to the fullest extent. The compartment should be properly designed internally to allow efficient handling of cargo when inside of the plane, to allow efficient use of the space available, and to allow easy and positive tying down of cargo once loaded.

If we look at a humble freight car we see a very simple enclosed space. The floor is flat and generally level, at a height from the ground that best fits into the economical design of the car and its loading. The car is about 40 feet long, eight feet wide and nine feet high. The doors are on the side and large enough to allow the rapid loading of cargo, being about six feet long by eight feet high on a normal car. This then gives an idea as to a practical compartment size to work toward. . . .

This then gives a place to start in the design of an efficient cargo plane. If at all possible, the cargo compartment should have a level floor, adequate width and height throughout its length. The loading door must be of ample size and should be so arranged to allow easy loading of the cargo.

The compartment must be located with respect to the wing in such a position as to hold the center of gravity of the airplane, loaded and unloaded, between the required limits for the airplane. . . .

There continually is expressed either personally or in the press a tremendous amount of misinformation concerning the utility and cargo carrying abilities of new, larger and different types of cargo planes. Much study has indicated certain general trends to expect in planes with varying size and various basic parameters.

For example, the designer is often told, "Make it bigger—or bigger yet—then we'll really have low cost transportation (or we'll really be able to carry a lot of pound-miles per hour)." Such a challenge is tough on the designer. He'd like to build them larger and larger; that's the way the imagination runs. But about this time some doubting Thomas breaks in and says, "Yes, but will we *really* be able to carry more pound-miles per hour per man-hours expended (or be able to carry cargo at a lower cost per pound-mile)?" Questions like this must be answered as they determine any common-sense solution of either military or commercial problems. . . .

For a given size of airplane the range at which maximum cargo utility is available and also the maximum range is naturally a function of the basic layout of the airplane. As a result, design conditions must be set up to define the conditions under which it is intended to use the airplane.

At the beginning of studies of a new plane consideration must be given to all factors insofar as possible in order to produce an efficient machine for the designed use. The basic factors to be considered for a cargo plane are:

1. *Weight*
2. *Drag*
3. *Span*
4. *Power*
5. *Stalling speed*
6. *Handling time*

1. Weight: As would be expected the effect of weight is comparatively large. Any increase of weight empty for a given gross weight will produce a corresponding reduction in cargo load. Under present emergency conditions cargo planes are being used as only visionaries would have normally thought only a short time ago. The present formula is to load the plane as heavy as you can take off—this is the flying weight. It must be remarked that the strength factors normally built into the airplane are definitely reduced by this process. If the practice is carried far enough the airplane may have to fly at restricted speeds in order to prevent structural failure

in bad weather conditions. The overload will also seriously affect the ceiling.

2. Drag: The designer naturally attempts to design the airplane to be as clean as feasible. Extreme care and sacrifice of weight may reduce the drag to some extent and likewise simplified and lighter design will often force a sacrifice in drag. Sometimes necessity forces cargo or other necessary items to be carried externally, causing extremely large changes in drag. Increase of drag also reduces ceiling, but less severely than weight.

3. Span: When maximum range is desired as much span is needed as possible in the state of the art at the time the design is frozen. However, it must be remembered that span costs weight and thus is not an unmixed blessing. The combined effects of span and the weight variations caused by span must be considered together. It will be noticed that a shorter span produces a more efficient airplane for short ranges, while the longer span holds up better at the longer ranges. Increase of span tends to increase ceilings.

4. Power: Power also produces combined effects. It does not affect the operational speed at speed for best range but it does allow the operational speed to be raised. Increase in installed power costs weight and as a result reduces the utility in the maximum range condition.

5. Stalling Speed: A large amount of work has been applied toward making the airplane a more versatile machine. Among the many items attacked have been the speed range. The top or operational speed has been continually increased by increased aerodynamic cleanliness, improved engines and structure. The stalling speed by necessity is being held in bounds by gadgetry which in many cases is a machine designer's despair.

6. Handling Time: This can lead us into considerable discussion of both military and commercial types. Handling time is defined as the total necessary time to fuel, load and unload the airplane. Strictly speaking, all layover time between flights due to bad planning, maintenance time and the like should be included but the latter are too unpredictable for a general discussion. . . .

Certain special conditions envisaged for the use of the cargo plane will often affect the basic design. Sometimes such conditions may be of such importance that a special design seems to be called for that is not an optimum arrangement for normal use. However, whenever possible, it is necessary to make any design of such a flexible nature that it will not be useless in every condition but one special type of use. This necessity produces the most headaches in the design room; to produce a design of good general utility that will also meet, or come close to meeting, all the special conditions of operation.

Military operations are a prime example and will be for the next few years. Much has been written lately by all of these unknown "experts" about how the cargo cirplanes will replace all the shipping and all the railroads. The more that we study this problem the more we feel that this is not the case. The cargo plane is an invaluable adjunct to present means of transport. Nothing else can deliver comparatively small quantities of critical material so rapidly over reasonable ranges. when velocity of replacement is needed the cargo plane is the thing. When mass of replenishment is necessary the ship still stands alone. But all the cargo planes that will be built will be none too many to take care of the "shock" requirements. This is our present field and it should be recognized as such.

It should also be realized that any airplane needs fuel. With the tremendous demands being made on our aviation fuel supply the problem becomes acute. Our western hemisphere is one great source of supply. The United Nations have only one other large source—the Near East. To save transportation of that fuel all over the world it would be most useful if all flights could be round trips without refueling from one of these sources.

Military operations sometimes do not have much choice as to cargo destination. If comparatively heavy cargo is carried suitable handling equipment must be carried within the airplane itself to allow proper cargo loading and unloading. This in many cases will present a considerable design problem.

Combat conditions bring a whole new set of troubles. Undoubtedly it will be necessary to fit some defensive protection to our military cargo planes that will be operating in or near the zone of operations. For tactical reasons glider tugs may be required with all of the structural and cooling troubles that are involved. Certain types of cargo planes for actual tactical use will have to be built with much of the design subordinated to extremely rapid unloading under fire. These are all

items that will require much design thought and ingenuity.

Commercial applications in the future will need more consideration in detail. It is well agreed that the quantity of traffic will increase terrifically in the future. This will require improved means of handling cargo, storing cargo, and dispatching cargo. Suggestions have been made for standard-size packaging. This is a good thought from the operator's standpoint but would undoubtedly cause considerable difficulty from the shipper's standpoint. The thing that appears to be necessary is more available flexibility in design for cargo stowage, not freezing of cargo size.

As cargo traffic increases the network of places served will also probably increase. At major terminals suitable facilities for cargo handling will be available, but at smaller stations this will not be the case. Three courses are open:

1. Design simple ground based handling devices.

2. Design suitable airplane carried handling equipment.

3. Design the airplane more with cargo loading in mind.

The first course is outside of our province, the second will involve a reduction in utility as we have seen. The probable answer will be to go as far toward designing for cargo handling as we can without suffering from weight and aerodynamic difficulties.

One other item should be mentioned briefly, that of supercharging. It is reasonable to assume that future passenger planes will be supercharged and it must be remembered that most future airplanes will carry a mixed load. The speeds of operation go up with increase in altitude, increasing the utility. Present indications are that the supercharged cabin cargo airplane will probably pay its way from the efficiency standpoint if the supercharged altitude for the airplane and its power plant is such that large weight penalties are not involved. This fact practically forces us to the circular fuselage or something quite close to it.

This brings us to the dream stage again—*what are the design trends in cargo planes?* Being a prophet is a sad business, as the best of well laid plans generally get changed. However, certain trends are evident both from a military and a commercial standpoint:

1. Operation at higher altitude is apparently on its way. Thus we may expect circular section fuselages.

2. The cargo compartment will have a flat floor and will be of the general dimensions of a freight car.

3. The use of airplanes for mixed cargo and passenger loads will call for a re-examination of airplane arrangement for more versatile use.

4. Every attempt will be made to reduce the distance from the ground to the cargo compartment. This may call for some rather freakish designs until we get on the beam. Figure 18 shows a present type of cargo ship and one means of bringing a low winged airplane closer to the ground. Figure 19 shows a high winged airplane. Note that the landing gear becomes excessively long. It also shows the same airplane with a cranked wing to reduce the landing gear length. Other types could be shown adinfinitum, but these give the general ideas that are brewing.

Presently available evidence indicates that we will have a terrific expansion in cargo transportation by air during and after the present war. Cargo compartments will undoubtedly be as simple and useful as possible, being of a design that is flexible enough to allow carrying of a large range of cargo. With proper care, both as to engineering practice and economy of use, many military airplanes will be convertible to cargo use. . . .

The only really effective way to increase the utility (or decrease the costs of operation) of cargo planes is to strip them down to a minimum weight empty or overload them above normal gross weights. The installed power must be as low as possible and still meet the legal or practical operating limitations. These things are very important either when economy is the test or when maximum utility is desired, as the cargo plane always works at a disadvantage from the standpoint of efficiency—it must be remembered that it may have a lift to drag ratio of 20 to 1, but a railway train has a lift to drag ratio of about 100 to 1, and a steamship operates at about 500 to 1. We must cut all the corners.

Thus it may be seen that the present intensive developments in military cargo planes may form the basis of future operations in peace time. The military cargo plane is essential to our winning of this war with its terrific problems of time and distance and, properly used, should provide *a powerful means of winning and maintaining the peace after this present convulsion is over.*

AIR TRANSPORTATION

AIR CARGO • FREIGHT • EXPRESS
MAIL • DOMESTIC • INTERNATIONAL

JOHN F. BUDD
Editor and Publisher

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AT's Platform

AIR TRANSPORTATION has no axe to grind except the best interest of its readers. It admits that it does not know all the answers. But it dedicates itself to trying to find them.

AIR TRANSPORTATION is not anti-ship, anti-rail or anti-truck. It is pro-air, because it believes that, sooner or later, CARGO-BY-AIR will be a mighty force in both domestic and international trade—a force that no shipper can ignore—a force with which every shipper should, in his own interest, be familiar. But it believes that there will continue to be a place for all recognized means of transportation—though many things are being drastically changed during the war and may be even more drastically changed when the war is won.

AIR TRANSPORTATION will explore the whole field of CARGO-BY-AIR from the Shipper's, Manufacturer's, Forwarder's, Importer's and Exporter's standpoints, *now while the whole mighty trend is forming.* It will try to give every reader a clear background of the future, as he must face it, once the war is over. It will offer a medium for exchange of ideas on shipping speeds, handling of cargoes, terminal facilities, shipping costs and all other angles of this great trend—so that when the day of its realization has come, each reader will be better equipped for the opportunities which that day will bring.

JOHN F. BUDD,
Editor and Publisher

What *Is* Air Cargo?

Last month, as all editors must, we ran into a man who didn't agree with our use of words. He said that when we referred to air *cargo,* we weren't talking about air express. When we used the words air cargo—and really meant air express, we were wrong. So ran his argument.

We didn't agree entirely then. We don't now. It was, in fact, quite an argument.

But to start with, let's have a look at the dictionary. It says:

> **car'go. Goods and merchandise taken on board of a vessel; lading; load.**

However, people who like to split hairs, and who think that when we of AIR TRANSPORTATION speak of air cargo, we mean such heavy stuff as bricks and coal and pig iron *and nothing else,* may also say: "Well, what of it? The dictionary was written before there was any air transportation."

So, for the sake of argument, let's skip the definition of Messrs. Webster, Funk & Wagnalls *et al.* Let's look, instead, to a professional air transport executive. Not only that, but to an executive who, by the far-flung influence of his company's achievement, has attained —we say without fear of contradiction— a unique place in world air transport. Let's see how he uses the phrase.

> *"Everyone realizes that spare parts and supplies have gone by air to our armed forces and to our Allies when surface transportation was too slow or unavailable. But what many of us do not know is that our overseas merchant air fleet already is moving* bulk cargo by air *(emphasis is ours.*—ED*). Materials which cannot wait for surface transport, or which are so vital to our war economy that they cannot be entrusted to surface vessels because of risk of loss, are being moved by air every day."*

The man who thus makes use of the phrase CARGO-BY-AIR is Juan Terry Trippe, president of PAN AMERICAN AIRWAYS, who should know.

Last month, we were proud to have made one of the major reports in AIR TRANSPORTATION an accounting of the brilliant manner in which Juan Trippe's great PAN AMERICAN organization has pioneered the transport of CARGO-BY-AIR throughout the Americas and—more recently—across both of the world's two greatest oceans. This month, we give an all too brief report of Mr. Trippe's own account of progress and forecast of the future, as delivered in person at the notable annual New York *Herald Tribune* Forum.

And right at this point, we're registering this point: To us, the movement of merchandise by air is AIR CARGO. Maybe it's express. Maybe it's freight. Maybe the aviation industry will, in time, think of a new and better word—though we doubt it.

And when we say AIR CARGO, we mean the regular, systematic movement of large quantities of merchandise by air —because the air is the most practical, most economical (all things considered) and soundest way to move it. We don't, it's true, think bricks and coal will be flying tomorrow. But on the other hand, we don't pin our faith on the "trick" shipments that were already making headlines with newspaper aviation editors 20 years ago.

CARGO-BY-AIR is what the words mean, according to Webster or according to Trippe. We stick to both definitions.

International Express and Mail Tables

Express rates quoted are from the U. S. international airport of departure and are based on the latest prevailing tariffs. Shippers are warned, however, that they are subject to change.

Bro—Brownsville
Eo—El Paso
Fv—Fort Worth
Lgs—Los Angeles
Mia—Miami
Nyk—New York
Ste—Seattle
Cg—Chicago
Sq—San Diego

International Air Express is subject to two charges: one a charge per pound weight or measurements at carrier's option (200 cu. in. to the pound of weight), the other a charge per $100 of valuation. The two must be added on any shipment to determine the cost. Neither includes the cost of insurance, which may be purchased by the shipper from the carrier or otherwise.

Priorities: The air carriers warn all shippers that express traffic, both U. S. Government and commercial, is so heavy that no guarantee can be given that any shipment will depart on any particular plane unless it enjoys U. S. priority. Otherwise it will depart, in relation to other shipments, in the order received at the international airport used, subject to wartime limitations. Shippers should forward cargo to international airports as far in advance of desired departure as possible and should communicate **via Railway Express Agency, Inc.** with the international air carrier as to whether the shipment can be forwarded without priority, as shipments without priority for certain countries are, at present, under embargo. (On cargoes to be shipped via American Export Airlines, Inc., shippers should inquire at their office, Room 920, 25 Broadway, New York.)

International air carriers whose schedules and rates are included here are indicated by the letter following the symbol for the airport of departure:

A—American Airlines, Inc.;
C—Colonial Airways;
E—American Export Airlines, Inc.;
P—Pan American Airways System and affiliate
T—Trans-Canada Air Lines.

LATIN-AMERICA LINES

Destination	U. S. Gateway & Airline	RATES Per Lb.	RATES Per $100 Value	Depart	Mail per ½ Oz.
Antilla, Cuba	Mia P	.24	.25	Dly ex W,Sa	.10
Antofagasta, Chile	Mia P	1.26	.50	M,W,Th,Sa	.40
"	Bro P	1.34	.50	M,Tu,Th,Sa	.40
"	Lgs P	1.95	.50	Su,M,W,F	.40
Aracaju, Brazil	Mia P	1.26	.50	Su,Tu	.40
"	Bro P	1.71	.50	Su,F	.40
"	Lgs P	2.28	.65	Th,Sa	.40
Areia Branca, Brazil	Mia P	1.24	.50	Su	.40
"	Bro P	1.58	.50	F	.40
"	Lgs P	2.13	.50	Th	.40
Arequipa, Peru	Mia P	1.23	.50	Dly ex F	.30
"	Bro P	1.26	.50	Dly ex W	.30
"	Lgs P	1.93	.50	Dly ex Tu	.30
Arica, Chile	Mia P	1.25	.50	M,W,Th,Sa	.40
"	Bro P	1.26	.50	M,Tu,Th,Sa	.40
"	Lgs P	1.94	.50	Su,M,W,F	.40
Asuncion, Para	Mia P	1.73	.50	Su,F	.40
"	Bro P	1.86	.50	W,F	.40
"	Lgs P	2.43	.65	Tu,Th	.40
Bahia, Brazil (*See Sao Salvador*)					
Balboa, Canal Zone	Mia P	.76	.40	Dly	.15
"	Bro P	.90	.40	Dly	.15
"	Lgs P	1.45	.50	Dly	.15
Baracoa, Cuba	Mia P	.28	.25	Dly ex Sa	.10
Barcelona, Venezuela	Mia P	.85	.40	Dly	.25
"	Bro P	1.17	.50	Dly	.25
"	Lgs P	1.78	.50	Dly	.25
Barranquilla, Columbia via Kingston	Mia P	.61	.40	Su,W,F	.35
via Balboa	Bro P	1.03	.40	Dly	.35
"	Lgs P	1.59	.50	Dly	.35
Bauru, Brazil	Mia P	1.58	.50	Su	.40
"	Bro P	1.71	.50	Th	.40
"	Lgs P	2.28	.65	W	.40
Belem, Brazil (*See Paramaw*)					
Bello-Horizonte, Brazil	Mia P	1.65	.50	Su,W,F	.40
"	Bro P	2.13	.50	M,W,F	.40
"	Lgs P	2.69	.65	Su,Tu,Th	.40
Buenos Aires, Argentina	Mia P	1.56	.50	Dly	.40
"	Bro P	1.70	.50	Dly ex W	.40
"	Lgs P	2.26	.65	Dly ex Tu	.40
Cali, Col. via Balboa	Mia P	.89	.40	Dly	.35
"	Bro P	1.03	.40	Dly	.35
"	Lgs P	1.59	.50	Dly	.35
Camaguey Cuba	Mia P	.26	.25	Dly	.10
Camocim, Brazil	Mia P	1.22	.50	Su	.40
"	Bro P	1.50	.50	F	.40
"	Lgs P	2.05	.50	Th	.40
Campeche, Mexico	Mia P	.41	.25	W	.10
"	Bro P	.51	.40	Dly	.10
"	Lgs P	1.00	.40	Dly	.10
Campo Grande, Brazil	Mia P	1.48	.50	Su, W	.40
"	Bro P	1.61	.50	M,W,Sa	.40
"	Lgs P	2.18	.50	Su,Tu,F	.40
Canavieiras, Brazil	Mia P	1.33	.50	Su,Tu	.40
"	Bro P	1.81	.50	Su,F	.40
"	Lgs P	2.38	.65	Th,Sa	.40
Caracas, Venezuela (*See La Guaira*)					
Caravellas, Brazil	Mia P	1.36	.50	Su	.40
"	Bro P	1.85	.50	F	.40
"	Lgs P	2.41	.65	Th	.40
Caripito, Venezuela	Mia P	.89	.40	Dly	.25
"	Bro P	1.19	.50	Dly	.25
"	Lgs P	1.80	.50	Dly	.25
Cayenne, Fr. Guiana	Mia P	1.02	.40	Su	.30
"	Bro P	1.26	.50	Sa	.30
"	Lgs P	1.91	.50	F	.30
Cayo Mambi, Cuba	Mia P	.26	.25	Dly ex Sa	.10
Chetumal, Mexico	Mia P	.55	.40	W	.10
"	Bro P	.55	.40	M,F	.10
"	Lgs P	1.04	.40	M,F	.10
Chiclayo, Peru	Mia P	1.11	.50	Dly	.30
"	Bro P	1.19	.50	Dly	.30
"	Lgs P	1.81	.50	Dly ex Tu	.30

Destination	U. S. Gateway & Airline	RATES		Depart	Mail per ½ Oz.
		Per Lb.	Per $100 Value		
Cienfuegos, Cuba	Mia P	.28	.18	Su,W,F	.10
C. del Carmen, Mexico	Mia P	.45	.25	W	.10
"	Bro P	.47	.40	Dly	.10
"	Lgs P	.94	.40	Dly	.10
Ciudad Trujillo, D. R.	Mia P	.45	.25	Dly	.10
Cochabamba, Bolivia	Mia P	1.26	.50	W,Sa	.35
"	Bro P	1.35	.50	M,Th	.35
"	Lgs P	1.95	.50	Su,W	.35
Concepcion, Bolivia	Mia P	1.31	.50	Sa	.35
"	Bro P	1.45	.50	Th	.35
"	Lgs P	2.03	.50	W	.35
Cordoba, Argentina	Mia P	1.49	.50	Dly ex F	.40
"	Bro P	1.63	.50	Dly ex W	.40
"	Lgs P	2.19	.50	Dly ex Tu	.40
Coro, Venezuela (via Barranquilla)	Mia P	.74	.40	Su,W	.25
"	Bro P	1.11	.50	Dly	.25
"	Lgs P	1.69	.50	Dly	.25
Coro, Venezuela (via Maracaibo)	Mia P	.74	.40	Tu,Sa	.25
Corumba, Brazil	Mia P	1.41	.50	Su, W	.40
"	Bro P	1.56	.50	Tu,Sa	.40
"	Lgs P	2.13	.50	M,F	.40
Cristobal, Canal Zone	Mia P	.76	.40	Dly	.15
"	Bro P	.92	.40	Dly	.15
"	Lgs P	1.46	.50	Dly	.15
Cuenca, Ecuador	Mia P	1.06	.40	Su,W,F	.30
"	Bro P	1.15	.50	M,W,F	.30
"	Lgs P	1.76	.50	Su,Tu,Th	.30
Curityba, Brazil (Via Rio)	Mia P	1.60	.50	Su,W,F	.40
"	Bro P	2.00	.50	M,W,Sa	.40
"	Lgs P	2.58	.65	Su,Tu,F	.40
David, Panama	Mia P	.82	.40	Dly	.15
"	Bro P	.85	.40	Dly	.15
"	Lgs P	1.38	.50	Dly	.15
Esmeraldas, Ecuador	Mia P	.99	.40	W	.30
"	Bro P	1.11	.50	M	.30
"	Lgs P	1.71	.50	Su	.30
Florianopolis, Brazil	Mia P	1.63	.50	Su,W,F	.40
"	Bro P	2.11	.50	M.W.F	.40
"	Lgs P	2.68	.65	Su,Tu,Th	.40
Fort de France, Martinique	Mia P	.71	.40	Su,Sa	.15
"	Bro P	1.16	.50	M,F	.15
"	Lgs P	1.78	.50	Su,Th	.15
Fortaleza, Brazil (Ceara)	Mia P	1.23	.50	Su,Tu,Th,Sa	.40
"	Bro P	1.54	.50	Su,Tu,Th,F	.40
"	Lgs P	2.10	.50	M,W,Th,Sa	.40
Georgetown, British Guiana	Mia P	.90	.40	Su,Sa	.30
"	Bro P	1.24	.50	Th,Sa	.30
"	Lgs P	1.88	.50	W,F	.30
Guadalajara, Mexico	Bro P	.43	.25	Dly	.10
"	Lgs P	.59	.40	Dly	.10
Guantanamo, Cuba	Mia P	.28	.25	Dly ex Su	.10
Guatemala City, Gua.	Mia P	.74	.40	Dly	.12
"	Bro P	.53	.40	Dly	.12
"	Lgs P	1.08	.50	Dly	.12
Guayaquil, Ecuador	Mia P	1.04	.40	Dly	.30
"	Bro P	1.15	.50	Dly	.30
"	Lgs P	1.75	.50	Dly	.30
Havana, Cuba	Mia P	.20	.18	Dly	.10
Hermosillo, Mexico	Bro P	.77	.40	Dly	.10
"	Lgs P	.24	.25	Dly	.10
Iguassu Falls, Brazil	Mia P	1.69	.50	Su,F	.40
"	Bro P	1.91	.50	W,F	.40
"	Lgs P	2.48	.65	Tu,Th	.40
Ixtepec, Mexico	Mia P	.76	.40	W	.10
"	Bro P	.41	.25	M,W,F	.10
"	Lgs P	.89	.40	M,W,F	.10
Joao Pessoa, Brazil (Cabedello)	Mia P	1.25	.50	Tu	.40
"	Bro P	1.64	.50	Su	.40
"	Lgs P	2.20	.50	Sa	.40
Kingston, Jamaica	Mia P	.39	.25	Su,W,F	.10
La Guaira, Venezuela	Mia P	.81	.40	Dly	.25
"	Bro P	1.15	.50	Dly	.25
"	Lgs P	1.75	.50	Dly	.25

Destination	U. S. Gateway & Airline	RATES		Depart	Mail per ½ Oz.
		Per Lb.	Per $100 Value		
La Paz, Bolivia	Mia P	1.25	.50	Su,Tu,W,Sa	.35
"	Bro P	1.30	.50	Su,M,Th,F	.35
"	Lgs P	1.95	.50	Su,W,Th,Sa	.35
Lima, Peru	Mia P	1.18	.50	Dly	.30
"	Bro P	1.24	.50	Dly	.30
"	Lgs P	1.88	.50	Dly	.30
Loja, Ecuador	Mia P	1.08	.50	Su,W,F	.30
"	Bro P	1.17	.50	M.W.F	.30
"	Lgs P	1.78	.50	Su,Tu,Th	.30
Maceio, Brazil	Mia P	1.26	.50	Su,Tu	.40
"	Bro P	1.68	.50	Su,F	.40
"	Lgs P	2.24	.50	Th,Sa	.40
Managua, Nicaragua	Mia P	.86	.40	Dly	.12
"	Bro P	.71	.40	Dly	.12
"	Lgs P	1.22	.50	Dly	.12
Manaos, Brazil	Mia P	1.24	.50	W,Sa	.40
"	Bro P	1.56	.50	M,Th	.40
"	Lgs P	2.13	.50	Su,W	.40
Manta, Ecuador	Mia P	1.03	.40	W,F	.30
"	Bro P	1.14	.50	Th,Sa	.30
"	Lgs P	1.74	.50	W,F	.30
Manzanillo, Cuba	Mia P	.26	.25	Dly ex Su	
Maracaibo, Venezuela (via Barranquilla)	Mia P	.69	.40	Su,W	.25
"	Bro P	1.08	.50	Dly	.25
"	Lgs P	1.66	.50	Dly	.25
Maracaibo, Venezuela (direct)	Mia P	.69	.40	Tu,Sa	.25
Masatlan, Mexico	Bro P	.57	.40	Dly	.10
"	Lgs P	.45	.25	Dly	.10
Medellin, Columbia (via Boquilla)	Mia P	1.06	.40	Su,W,F	
Medellin, Columbia (via Balboa)	Mia P	1.06	.40	Tu,Sa	
"	Bro P	1.10	.50	M,Th,F	
"	Lgs P	1.65	.50	Su,W,Th	
Mendoza, Argentina	Mia P	1.41	.50	M,W,Th,Sa	.40
"	Bro P	1.55	.50	M,Tu,Th,Sa	.40
"	Lgs P	2.11	.50	Su,M,W,	.40
Merida, Mexico	Mia P	.37	.25	W	.10
"	Bro P	.55	.40	Dly	.10
"	Lgs P	1.04	.40	Dly	.10
Mexicali, Mexico	Lgs P	.20	.18	Dly	.10
Mexico City, Mexico	Mia P	.69	.40	W	.10
"	Bro P	.26	.25	Dly	.10
"	Lgs P	.69	.40	Dly	.10
"	Lgs A	.70	.35	Dly	.10
"	Fv A	.42	.25	Dly	.10
"	Eo A	.42	.25	Dly	.10
"	Sq A	.74	.35	Dly	.10
Minatitlan, Mexico	Mia P	.53	.40	W	.10
"	Bro P	.39	.25	Dly	.10
"	Lgs P	.86	.40	Dly	.10
Monterrey, Mexico	Fv A	.34	.25	Dly	.10
"	Eo A	.34	.25	Dly	.10
"	Lgs A	.62	.35	Dly	.10
"	Sq. A	.74	.35	Dly	.10
Montevideo, Uruguay* (See notes below)					
Nassau, Bahamas	Mia P	.20	.18	Dly ex Su,W	.10
Natal, Brazil	Mia P	1.25	.50	Su,Tu,Th,Sa	.40
"	Bro P	1.61	.50	Su,Tu,Th,F	.40
"	Lgs P	2.18	.50	M,W,Th,Sa	.40
Oruro, Bolivia	Mia P	1.26	.50	Su,Tu,Th	.35
"	Bro P	1.33	.50	Su,Tu,F,Sa	.35
"	Lgs P	1.95	.50	M,Th,F,Sa	.35
Panama City, Panama (*See Balboa, C. Z.*)					
Para (Belem), Brazil	Mia P	1.13	.50	Dly ex M	.40
"	Bro P	1.34	.50	Dly ex Sa	.40
"	Lgs P	1.95	.50	Dly ex F	.40
Paramaribo, Sur	Mia P	.97	.40	Dly ex Su	.30
"	Bro P	1.25	.50	Dly ex F	.30
"	Lgs P	1.90	.50	Dly ex Th	.30

* Shipments for Montevideo must be assessed rates to Buenos Aires plus 55c per 2 lbs. or fraction thereof (min. 55c) for forwarding by other carrier to Montevideo, plus $1.10 per shipment transfer charge at Buenos Aires.

Destination	U. S. Gateway & Airline	RATES		Depart	Mail per ½ Oz.
		Per Lb.	Per $100 Value		
Parnahyba, Brazil	Mia P	1.21	.50	Su	.40
"	Bro P	1.48	.50	F	.40
"	Lgs P	2.04	.50	Th	.40
Point a Pitre, Guadeloupe	Mia P	.66	.40	Su,Sa	.15
"	Bro P	1.14	.50	M,F	.15
"	Lgs P	1.74	.50	Su,Th	.15
Port au Prince, Haiti	Mia P	.37	.25	Dly	.10
Port of Spain, Trinidad	Mia P	.79	.40	Dly ex Su	.15
"	Bro P	1.20	.50	Dly	.15
"	Lgs P	1.81	.50	Dly	.15
Porto Alegre, Brazil	Mia P	1.70	.50	Su,W,F	.40
"	Bro P	2.19	.50	M,W,Sa	.40
"	Lgs P	2.75	.65	Su,Tu,F	.40
Puerto Suarez, Bolivia	Mia P	1.41	.50	M,Th	.35
"	Bro P	1.56	.50	Tu,Sa	.35
"	Lgs P	2.13	.50	M,F	.35
Preston, Cuba	Mia P	.24	.25	Dly ex Sa	.10
Quito, Ecuador	Mia P	.97	.40	Dly	.30
"	Bro P	1.09	.50	Dly	.30
"	Lgs P	1.68	.50	Dly	.30
Recife, Brazil	Mia P	1.26	.50	Su,Tu,Th,Sa	.40
"	Bro P	1.65	.50	Su,Tu,Th,F	.40
"	Lgs P	2.21	.50	M,W,Th,Sa	.40
Rio de Janeiro	Mia P	1.50	.50	Su,W,F	.40
"	Bro P	1.98	.50	M,W,F	.40
"	Lgs P	2.54	.65	Su,Tu,Th	.40
Robore, Bolivia	Mia P	1.38	.50	Th	.35
"	Bro P	1.51	.50	Tu	.35
"	Lgs P	2.08	.50	M	.35
Salinas, Ecuador	Mia P	1.05	.40	Th, Sa	.30
"	Bro P	1.15	.50	Tu, Th	.30
"	Lgs P	1.75	.50	M,W	.30
Salta, Argentina	Mia P	1.30	.50	Su,Tu	.40
"	Bro P	1.45	.50	Su,F	.40
"	Lgs P	2.03	.50	Th,Sa	.40
San Ignacio, Bolivia	Mia P	1.33	.50	Th	.35
"	Bro P	1.48	.50	Tu	.35
"	Lgs P	2.04	.50	M	.35
San Jose, Bolivia	Mia P	1.35	.50	Th	.35
"	Bro P	1.50	.50	Tu	.35
"	Lgs P	2.08	.50	M	.35
San Jose, Costa Rica	Mia P	.89	.40	Dly	.15
"	Bro P	.76	.40	Dly	.15
"	Lgs P	1.31	.50	Dly	.15
San Juan, Puerto Rico	Mia P	.53	.40	Dly	.10
San Salvador, El Salvador	Mia P	.79	.40	Dly	.12
"	Bro P	.61	.40	Dly	.12
"	Lgs P	1.14	.50	Dly	.12
Santa Cruz, Bolivia	Mia P	1.28	.50	M,Th	.35
"	Bro P	1.43	.50	Tu,Sa	.35
"	Lgs P	1.99	.50	M,F	.35
Santiago, Chile	Mia P	1.38	.50	M,W,Th,Sa	.40
"	Bro P	1.51	.50	M,Tu,Th,Sa	.40
"	Lgs P	2.08	.50	Su,M,W,F	.40
Santiago, Cuba	Mia P	.26	.25	Dly ex Su	.10
Sao Luiz, Brazil	Mia P	1.19	.50	Su,Tu,Th,Sa	.40
"	Bro P	1.43	.50	Su,Tu,Th,F	.40
"	Lgs P	1.99	.50	M,W,Th,Sa	.40
Sao Paulo, Brazil (via Rio)	Mia P	1.55	.50	Su,W,F	.40
"	Bro P	2.04	.50	M,W,Sa	.40
"	Lgs P	2.60	.65	Su,Tu,F	.40
Sao Salvador, Brazil (Bahia)	Mia P	1.28	.50	Su,Tu,Th,Sa	.40
"	Bro P	1.76	.50	Su,Tu,Th,F	.40
"	Lgs P	2.33	.65	M,W,Th,Sa	.40
St. Johns, Antigua, British West Indies	Mia P	.64	.40	Sa,Su	.15
"	Bro P	1.13	.50	M,Sa	.15
"	Lgs P	1.73	.50	Su,F	.15
St. Thomas, V. I.	Mia P	.57	.40	Sa,Su	.10
"	Bro P	1.10	.50	M,F	.10
"	Lgs P	1.68	.50	Su,Th	.10
Talara, Peru	Mia P	1.08	.50	Dly	.30
"	Bro P	1.17	.50	Dly	.30
"	Lgs P	1.79	.50	Dly	.30
Tampico, Mexico	Bro P	.20	.18	Dly	.10
"	Lgs P	.81	.40	Dly	.10
Tapachula, Mexico	Bro P	.53	.40	Dly	.10
"	Lgs P	1.02	.40	Dly	.10
Tegucigalpa, Honduras	Mia P	.82	.40	Dly	.12
"	Bro P	.68	.40	Dly	.12
"	Lgs P	1.18	.50	Dly	.12
Tres Lagoas, Brazil	Mia P	1.53	.50	Su	.40
"	Bro P	1.66	.50	We	.40
"	Lgs P	2.23	.50	Tu	.40
Tucuman, Argentina	Mia P	1.34	.50	Su,Tu	.40
"	Bro P	1.49	.50	Su,F	.40
"	Lgs P	2.05	.50	Th,Sa	.40
Turbo, Columbia (via Barranquilla)	Mia P	1.06	.40	Su,W,F	
Turbo, Columbia (via Balboa, C. Z.)	Mia P	1.06	.40	Tu,Sa	
"	Bro P	1.10	.50	M,Th,F	
"	Lgs P	1.65	.50	Su,W,Th	
Tuxpan, Mexico	Bro P	.20	.18	Dly	
"	Lgs P	.83	.40	Dly	
Uyuni, Bolivia	Mia P	1.26	.50	Su,Tu	.35
"	Bro P	1.38	.50	Su,F	.35
"	Lgs P	1.95	.50	Th,Sa	.35
Veracrus, Mexico	Mia P	.57	.40	We	.10
"	Bro P	.33	.25	Dly	.10
"	Lgs P	.79	.40	Dly	.10
Victoria, Brazil	Mia P	1.41	.50	Su,Tu	.40
"	Bro P	1.90	.50	Su,F	.40
"	Lgs P	2.46	.65	Th,Sa	.40
Villahermosa, Mexico	Mia P	.49	.40	We	.10
"	Bro P	.43	.25	Dly	.10
"	Lgs P	.90	.40	Dly	.10

ATLANTIC LINES

Botwood, Newfoundland	Nyk P	.81	.40	Twice wk	.15
England via Foynes*	Nyk E	(Rates	on	Application)	.30
" *	Nyk P	(Rates	on	Application)	.30
Foynes, Eire	Nyk P	1.78	.50	Twice wk	.30
"	Nyk E	2.00	.50	.....	.30
Hamilton, Bermuda	Nyk P	.55	.25	Twice wk	.10
"	Nyk E	.55	.25	.....	.10
Horta, Azores	Nyk P	1.70	.40	Once 2 wks	.30
Lisbon, Portugal	Nyk P	2.00	.50	Once 2 wks	.30
Scotland via Foynes*	Nyk E	(Rates	on	Application)	.30
" *	Nyk P	(Rates	on	Application)	.30
Shediac, N. B.	Nyk P	.51	.25	Twice wk	.08
Wales via Foynes*	Nyk E	(Rates	on	Application)	.30
" *	Nyk P	(Rates	on	Application)	.30

ALASKA LINES

Bethel, Alaska	Ste P	1.11	.40	Schedules not published	.06
Fairbanks, "	Ste P	.90	.40	"	.06
Flat, "	Ste P	1.05	.40	"	.06
Galena, "	Ste P	1.00	.40	"	.06
Golovin, "	Ste P	1.08	.40	Nov. 1-Apr. 30	.06
Hot Springs, "	Ste P	.92	.40	Nov. 1-Apr. 30	.06
Juneau, "	Ste P	.56	.25	Schedules not published	.06
McGrath, "	Ste P	1.00	.40	"	.06
Nome, "	Ste P	1.11	.40	"	.06
Nulato, "	Ste P	1.03	.40	Nov. 1-Apr. 30	.06
Ophir, "	Ste P	1.03	.40	Schedules not published	.06
Ruby, "	Ste P	.99	.40	"	.06
Tanana, "	Ste P	.95	.40	Nov. 1-Apr. 30	.06
Whitehorse, Canada	Ste P	.66	.40	Schedules not published	.06

CANADIAN LINES

Toronto, Canada	Nyk A	.16	†	Dly	.06
"	Nyk T	.16	†	Dly	.06
Montreal, Canada	Nyk C	.12	†	Dly	.06
Windsor, Canada	Nyk A	.20	†	Dly	.06
"	Cg A	.12	†	Dly	.06

* British Overseas Airways Corp. carries from Foynes, Ireland, to destinations in England, Scotland, and Wales.

† Canadian air express is carried on the same basis as air express within the U. S.: $50 declared value free; excess charged at 10 cents per $100 or fraction thereof.

Mail per ½ Oz.
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